The
Dock & Harbour Authority

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Dredging in Australia . . .

All-round popularity of the Priestman System

Since 1879, a steady flow of Priestman Grab Dredging Equipment has left Hull for Australia. At least 80 Priestman Grab Dredgers are now operating in that country, and among the Australian Harbour Authorities who have purchased Priestman plant since the war are—Brisbane, Perth, Launceston, Sydney and Melbourne.

Melbourne Harbor Trust

In 1949 this important Authority took delivery of a Priestman No. 60 size diesel driven grab dredging crane of 3 cu. yds. capacity. This dredger has carried out a great deal of work for the Trust including, amongst other things, salvage work for which of course the grab dredge is particularly well suited.

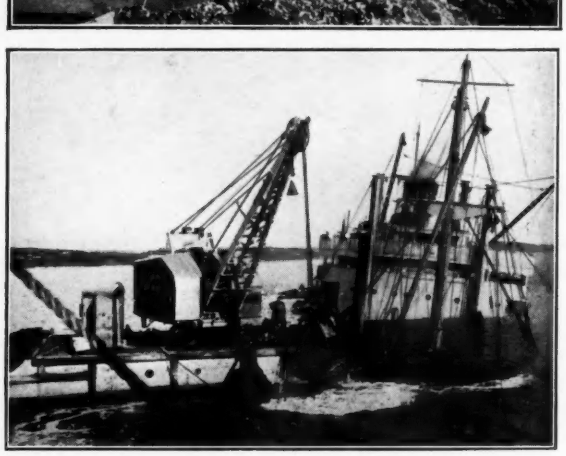
As a result of their experiences with this first machine the Harbor Trust have placed an order for a similar machine which will be delivered in the middle of 1957.

The Maritime Services Board, Sydney, N.S.W.

In addition to two earlier Priestman dredgers, the "Pan" and the "Duplex," this Board have a post-war Priestman No. 60 size steam-driven dredging crane of 3 cu. yds. capacity mounted on the grab hopper dredger "Burra Bru," built by the Morts Dock & Engineering Co. Ltd.

This vessel, with a hopper capacity of 300 tons, has a length of 131-ft., a breadth of 28-ft., a depth of 12-ft. with a loaded draft of 10-ft. Propelled by twin screws with engines developing 700 I.H.P., it has a loaded speed of 10¼ knots. On trials the hopper was filled in less than two hours with 66 lifts by the dredging crane.

(Photograph of the "Burra Bru" reproduced by courtesy of the Maritime Services Board).



Harbours and Marine Dept., Brisbane

After their original Priestman dredger had rendered 62 years of service, this Authority ordered their second Priestman. This was a Priestman No. 60, 3 cu. yd. diesel driven dredging crane which they mounted on their own barge, the "Tridacna."

This dredger discharges spoil into barges alongside which are then towed away for the spoil to be dumped at distances of up to 18 miles.

In 477 working hours the dredger raised over 30,000 barge yards of mud and sand at a cost of approximately 1/6 per cubic yard excluding capital costs.

In November the Harbours and Marine Dept. placed another order for a 2 cu. yd. diesel driven Priestman Grab dredging crane.

P.W.D., Perth, Western Australia

The grab dredger "Fremantle" was built for the P.W.D. of the Western Australia Government by the Morts Dock and Engineering Co. Ltd. of Sydney. This dredger, which has a hopper capacity of 320 tons, has dimensions as follows: length 136-ft., breadth 34-ft., depth 10-ft., loaded draft 7-ft. 9-in.

Fitted with a Priestman No. 40 size diesel driven dredging crane; operating either a 2 cu. yd. mud grab or a 1½ cu. yd. grab for stones and similar material, the vessel has a 350 B.H.P. marine type oil engine with a loaded speed of 8.8 knots.

Launceston, Tasmania

The Marine Services Board at Launceston purchased their first Priestman dredger in 1884, and in 1951, although their original dredger was still in operation, they decided to purchase a second Priestman. This new order covered the supply of a Priestman No. 20 size diesel driven dredging crane which operates a 1 cu. yd. mud grab at a maximum radius of 28-ft. In addition to carrying out normal dredging work, one vessel is also employed for coaling the Board's other dredger and is kept fully employed within the Harbour area.

ILLUSTRATIONS

Top right—Perth Public Works Dept. Grab-Hopper Dredger "Fremantle."

Centre—The Maritime Services Board, Sydney, Grab-Hopper Dredger "Burra Bru" working in Sydney Harbour.

Bottom—The Melbourne Harbor Trust Pontoon-mounted Dredger assisting in salvage operations.

The Dock & Harbour Authority

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Editorial Comments

The Port of Swansea.

Situated at the western end of the chain of South Wales ports, Swansea Docks has a total water area of 223 acres. With a population of some 170,000 people the town is a modern industrial and shipping centre of considerable importance. An account of the history and development of the port is given in the following pages.

The early history of Swansea appears to have been anything but peaceful. In 1099, the Earl of Warwick founded the Castle at the mouth of the River Tawe and thereafter, this was the scene of continual conflict between the Welsh Chieftains and the English and Norman invaders. Some hundreds of years later, at the time of the Commonwealth, Oliver Cromwell seized the castle and this marks the last occasion when a clash of arms was experienced in the town.

The town's industrial history may be said to date from the early 18th century when copper smelting was introduced to the locality. Other industries followed, and it is interesting to note that to-day Swansea is the principal port for the export of that commodity. The anthracite area of the South Wales coalfield is sited near the port which has consequently become the main shipping point for this class of coal. In recent years, however, the comparatively new oil trade has rapidly developed at the port so that now Swansea claims to be one of the busiest oil importing ports in the country, over 2½ million tons being handled annually. A considerable proportion of the imported oil is returned to the docks after refining and is shipped for wide distribution.

Swansea is more fortunate than her sister ports in South Wales in that her normal export trade other than coal, in proportion to total imports and exports, is far greater, doubtless by reason of the number and variety of industries located at or near the port. She is, therefore, not so seriously affected by fluctuations in trade and so is able to maintain a more balanced economy.

Port Facilities for Supertankers.

It has become increasingly evident in recent years that a significant change is taking place in the design of ships used in the transportation of bulk petroleum and ore. Ten years ago vessels carrying these cargoes were built to approximately the same dimensions as dry cargo ships; now they are being designed on a scale that dwarfs all but the largest superliners. The development of these "super" ships has resulted from the economies inherent in their operation and the consequent savings in the cost of transporting bulk commodities. The economic advantages that are possible through the use of "super" ships depend, of course, on the ability of the ports throughout the world to accommodate them.

With this in mind the Port of New York Authority has undertaken a survey to determine the adequacy of the Port's channels to accommodate this type of large vessel. At a public hearing held by the United States Army Corps of Engineers, the Authority has recommended deepening from 35 to 45-ft. of the New York and New Jersey channels. It was stated at this hearing that if the 30 million tons of oceanborne petroleum received in the Arthur Kill and Kill van Kull waterways during 1956 were to be handled by fully-loaded supertankers of the 45,000-ton class rather than in the present T-2 size tanker, an annual ship operating saving of $30 million would be realised.

The Authority's case for the enlarging of the channels, including the deepening and widening of the seaway approaches to connect with the famous Ambrose Channel, is given in an article entitled "Proposed channel improvements by the Port of New York Authority." This article is an important one in that it demonstrates a serious attempt to solve the problem posed by the supertanker, a problem which is causing great concern to port authorities throughout the world.

The Baltic Conference.

Every two years the Baltic and International Maritime Conference assembles in a European capital for a gathering which is a judicious admixture of business and entertainment. To these meetings come delegates from all over the world. The membership embraces quite a large number of shipbrokers as well as shipowners and documentary matters such as charterparties occupy a good deal of the time. Originally the conference was largely confined to Baltic trades as the name implies, but in recent years its activities have been extended in range and it now deals with a number of subjects of wider import. The tonnage entered by British shipowners is fairly substantial and the presidency has been held by representatives of the United Kingdom.

The conference this year was held in Paris and an extended report of the meetings will be found elsewhere in this issue. It will be seen that the discussions all have an impact upon docks and harbours. The movement of phosphates—now one of the most important tramp ship cargoes—shows that Great Britain receives the third largest tonnage exported. The revival forecast for the Argentine grain trade must have a reaction on world markets. The suggestion in the presidential address that too much tonnage may be under construction or on order cannot be lightly disregarded.

In two years' time the conference will come to London, a city it has not visited for over 30 years, and in accordance with custom Mr. F. P. Longton, now president-delegate, will preside over the meeting.

Sea Transportation of Cargo in Trailer Vans and Railway Wagons.

A symposium of "roll-on, roll-off" sea transportation was convened in Washington during November, 1956, by the Maritime Cargo Transportation Conference (M.C.T.C.)—U.S. National Research Council. The M.C.T.C. is conducting a series of studies for the purpose of providing guidance on means and techniques leading to improvements in the sea transportation of dry cargo and to determine critical factors and remedial measures to reduce ship turn-round times. An investigation of the system by which cargo is rolled on and off ships in trailer vans and railway vehicles, is one of the series; and the symposium, at which seven papers were presented, was convened for the furtherance of this study.

The operation of a hypothetical new general cargo vessel was compared with that of a hypothetical new trailership of the same speed and the conclusion was reached that, especially for longer voyages, the importance of ship construction and operating costs is overwhelming in roll-on, roll-off sea-transportation.

Two papers read by members of the M.C.T.C. staff concentrated on making this comparison and extracts from them have been printed on page 59 of this issue. This study is yet further evidence of the attention which is still being given to quick turnround and to the benefits of transporting goods in load form rather than as separate packages.

Topical Notes

International Hydrographic Conference.

The seventh conference of the International Hydrographic Bureau was recently held at Monte Carlo. Most of the member States, expected shortly to reach a total of 36, sent delegates whilst observers from non-member States and scientific bodies were present. In addition to the conference there were various lectures on hydrographic matters. There was also an exhibition, in the Monaco Customs Hall, of hydrographic instruments and equipment, including displays by a number of British firms.

The International Hydrographic Bureau was founded in 1921 and has, as one of its principal objects, the co-ordination of the hydrographic work between the services of its member States with a view to rendering navigation safer and easier in all the seas of the world.

Labour at New Zealand Docks.

Recent reports in the New Zealand press indicate that there has been an improvement in results in New Zealand Port labour working. Taking all ports into consideration the average speed for the loading of overseas cargo has increased by 3.66 tons per gang hour, an increase of more than 20 per cent., and the average for discharging overseas cargo has increased by almost five tons per gang hour, an increase of more than 40 per cent.. Last year, 490 fewer workers than in 1949 were responsible for the handling of 2,341,000 more tons of cargo. An interesting point has been the very considerable increase in the amount of wages earned by dockside workers. In 1949-50 the average earnings on the waterfront for a working week of 44¾ hours, including 11¼ hours overtime, were £11 17s. 4d.; last year, for a working week of 47½ hours, including 12¼ hours overtime, the average earnings were £20 2s. 8d. This represents an increase of more than 69 per cent.

Anti-Corrosion Convention.

At a recent meeting of the Institution of Civil Engineers, Dr. W. H. J. Vernon stated that industry's annual bill for metallic corrosion losses in the United Kingdom alone amounts to more than six hundred million pounds.

In a special effort to reduce these losses a "National Anti-Corrosion Week" is to be held from 14th—19th October next. During this period, it is hoped that a fresh impetus will be given to fighting corrosion. New information concerning corrosion and its prevention will be disseminated and the organisers believe that the additional publicity given to the subject will lead to a more realistic estimate of its importance.

During the week, there will be a two-day Corrosion Convention which will be held at Central Hall, Westminster, on October 15 and 16. Delegates will attend from overseas as well as from this country and Papers will be given by leading authorities on many aspects of corrosion and its treatment. Engineering and technical societies and Government departments are to co-operate.

In addition, there will be a three-day Corrosion Exhibition at the Royal Horticultural Society's Old Hall from October 15 to 17. This is the first full-scale exhibition ever to be held in this country, and much space has already been booked by exhibitors. It will be open to the general public.

Radio Position Fixing System in Canada.

It has been announced that, by arrangement with the Canadian Department of Transport, tests are being conducted on a new Decca Navigator continuous radio position fixing system for shipping. The first of four chains of ground stations, named "Moose West," located on the south coast of Newfoundland, is already in operation. The second chain, "Moose East" located near Gander, Newfoundland, was due to commence operating in May.

Two other chains, "Caribou East" and "Caribou West," to be located in the vicinities of Halifax and Quebec and giving coverage to Nova Scotia and the St. Lawrence river, are expected to go into operation early in August. Each system consists of a master transmitting station and three slave stations located approximately 80 miles apart and each giving continuous navigation coverage to areas of about 200,000 square miles.

The Minister of Transport said that his department was hoping for the installation of receiving equipment in a large cross-section of shipping so that the evaluation test period would be as informative as possible. He urged all potential users to avail themselves of this opportunity to make their own trials of its usefulness. Receiving equipment was available on a rental basis, and some trans-Atlantic liners and cargo vessels were now equipped with Decca receiving sets which were used in European waters.

Mobile chains of the Decca position-fixing system have been in use in Atlantic coastal waters since 1955 for test and evaluation by the Royal Canadian Navy and the Hydrographic Service of the Department of Mines and Technical Surveys. The Grand Banks fishing ground is expected to be within the range of the "Moose" and "Caribou" chains which will be beneficial to any fishing vessel equipped with the required receivers.

Investigation into Working of Singapore Harbour.

It was announced early this month that a port commission has been appointed to examine the working and future of Singapore Harbour. The Commission will consist of eight members, four of whom are British, and will start work in August of this year.

Sir Eric Milbourn, honorary adviser on ports to the British Ministry of Transport and Civil Aviation, has been appointed Chairman, and serving with him will be Mr. Francis H. Cave, lately general manager of the Mersey Docks and Harbour Board, Sir Ian Parkin, who was general manager of the National Dock Labour Board until 1956, and Mr. Colin C. Black who has recently retired from the board of Furness, Withy and Co. Ltd. The Commission, which has been appointed by the Government of Singapore, will examine all port facilities, development plans and sources of revenue, and will report on whether there should be a separate dock labour authority to control the supply of labour on the waterfront.

Panama Canal Improvements.

According to the annual budget of the Panama Canal Company, which has recently been submitted to the U.S. Congress, expenditures for the coming fiscal year will include an extensive improvement programme. A sum of $6,250,000 is budgeted for the replacement of the towing locomotives and one of the principal items in the canal improvement work is a three-year scheme to improve the channel just north of Pedro Miguel Locks at a total cost of $1,800,000. The work in the cut between Gold Hill and Pedro Miguel will involve the removal of 650,000 cubic yards of earth and rock to cut away a section of bank jutting into the canal, and widen the channel.

All previous records for the number of large ocean-going commercial vessels were broken during December last, although the total number of transits for the first six months of the current fiscal year was slightly lower than the comparable period in 1956.

The number of ocean-going commercial transits was less during the first six months of 1957 than during the first six months of 1956, but the tolls collected exceeded those for the first six months of 1956 by almost $200,000. This improvement is attributed to the increase in size of ships using the Panama Canal, particularly tankers. The United States continued to be the largest user of the canal and there was a marked increase in the number of vessels carrying the Liberian flag.

New Bulk Sugar Terminal at Mackay, Queensland.

The first bulk sugar terminal to be constructed in Queensland, Australia, is due to be completed at Mackay next month in time for the 1957 crushing season. The terminal, which is being constructed by the Mackay Harbour Board on behalf of the Queensland Sugar Board, will be the main terminal for storing, loading and shipping approximately 250,000 tons of raw sugar each season. At present, it takes about three weeks to load a 10.000 ton vessel, but when the new terminal is in operation, it is expected loading will be completed in one day. Sugar will be delivered in bulk to the terminal by rail and road and will be then stored in hoppers having a storage capacity of some 150,000 tons.

Other bulk sugar terminals are planned for Cairns, Mourilyan, Lucinda, Townsville and New Bundaberg, but these installations will not be ready for this season's shipments.

The Port of Swansea

Its History and Development

SITUATED at the mouth of the River Tawe, at the western extremity of the chain of principal South Wales Docks, Swansea to-day is a modern industrial centre of considerable importance. The establishment of the copper smelting industry in the vicinity early in the eighteenth century can be said to be the basic reason for the port's development. The shipment of coal, however, was well established on a small scale two hundred years earlier, and from this it may be assumed that ships and shipping were even then a familiar feature in Swansea Bay.

As the copper works in the area expanded, it became necessary to look further afield for the ore, which was originally obtained from Cornwall, and in time a fleet of sailing ships bringing cargoes from as far as South America was based on the port.

Other industries followed, one of major importance being the manufacture of tinplate, and by the end of the eighteenth century Swansea was a highly industrialised town and an important seaport.

Before 1790, the port consisted of a few wharves near the mouth of the river, and it was only after several attempts by interested townspeople to make some improvements in the condition of the harbour (which were opposed by the Swansea Corporation, who had control of the river for a considerable distance along the west side) that eventual agreement was reached with the Corporation, and a Bill promoted for improvements to the Harbour. This Bill which became the Swansea Harbour Act of 1791, authorised the formation of the Swansea Harbour Trust, and provided for repairs, enlargements and preservation of the harbour, the establishment of the Mumbles Lighthouse and certain initial facilities in the way of piers, etc.

The year 1798 saw the completion of the construction of the Swansea Canal, which brought traffic from the Swansea Valley to the Harbour for transhipment to sea-going vessels.

The Swansea Harbour Trustees took in hand the construction of two piers to form a protection to the Bay at the mouth of the river, and in 1809 the Outer Harbour construction was complete. This led to the development of facilities on the eastern side by a Mr. George Tennant of Neath, who built at his own expense a canal from Neath to Swansea Harbour, and this canal was opened in 1824. At the Swansea end of the canal, "Port Tennant" was established in 1826.

As vessels increased in size, so the need became urgent to construct an enclosed dock, and early in the nineteenth century the Harbour Trustees adopted a scheme to divert the River Tawe near its entrance to the sea, and to use the old bed of the river as a float In 1836, an Act of Parliament was passed empowering the Trustees to proceed with these works, which were not started however until 1840, and the diversion of the river was completed in 1844.

Difficulties were encountered in the construction of the dock, which was not opened until 1852, and was then known as the Town Float, later being renamed the North Dock.

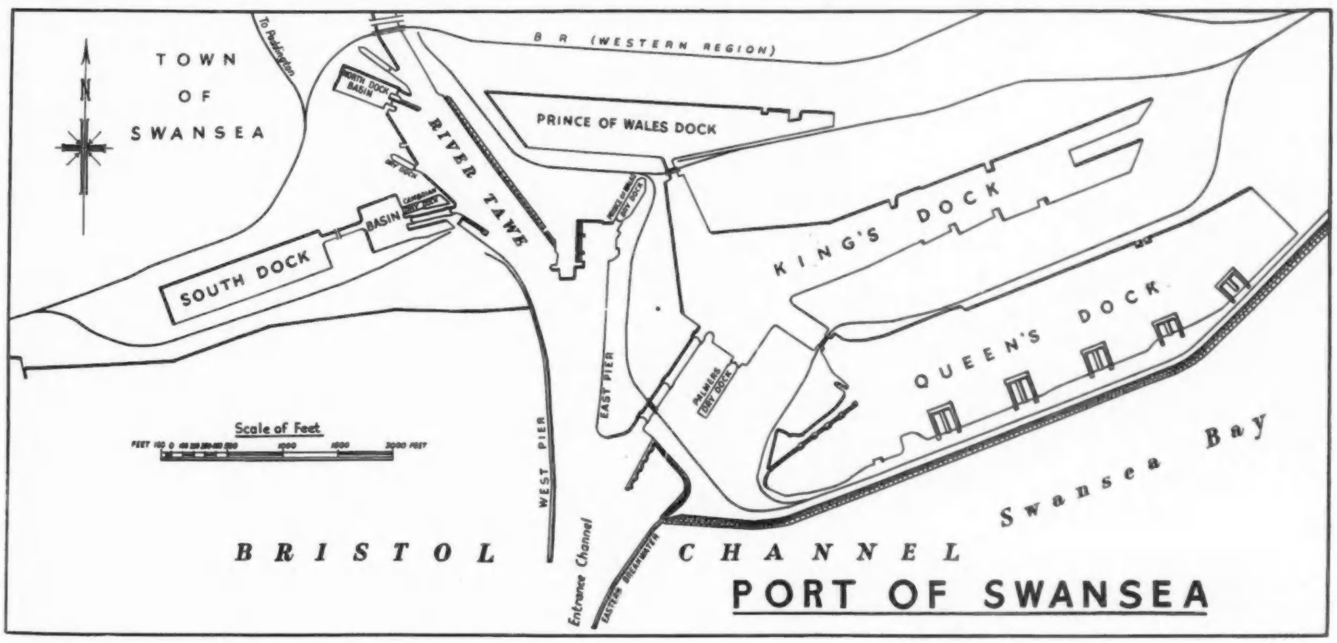
Before the North Dock had been constructed, it was obvious that the growth of industry in the area called for further dock facilities. On the recommendation of Mr. I. K. Brunel, the famous engineer of that time, the Swansea Dock Company, a private Company promoted by the Duke of Beaufort, propounded a scheme for the construction of a dock on the west side of the river. The Swansea Docks Act of 1847 authorised the construction of this dock which was afterwards known as the South Dock. The Marquis of Worcester, son of the Duke of Beaufort, cut the first sod of the South Dock in 1852 and work on it continued until 1855, when it was suspended through lack of funds.

The Duke of Beaufort and the Swansea Harbour Trustees, which body had been incorporated by the Swansea Harbour Act of 1854, realising that their aims for Swansea Docks were sympathetic, came to agreement. A new Act of Parliament was passed, under which the Swansea Dock Company's works and undertaking were transferred to the Harbour Trustees, who by 1859 completed the project and opened the South Dock for traffic.

The dimensions of the South Dock are as follows:—

Length of Dock	1,538-ft.
Width of Dock	360-ft.
Area of Dock	13 acres.
Length of Entrance Lock	370-ft.
Width of Entrance Lock	58-ft.
Average depth on outer cill H.W.O.S.T.	34-ft.
Average depth on outer cill H.W.O.N.T.	26½-ft.

In 1850, the South Wales Railway completed their line into Swansea and came to an arrangement with the Harbour Trustees to ship coal by hydraulic machinery at the North Dock. To enable this



The Port of Swansea—*continued*

A typical cargo awaiting shipment in Transit Shed at Swansea Docks.

to be done, the Swansea Harbour Trustees constructed their own railway to connect the dock with the South Wales Railway. In 1863 another railway was completed from Neath to Swansea, thus bringing further coalfields into direct communication with Swansea Docks.

The Harbour Trustees, who were now the owners of two docks, aspired to make Swansea a first-class port, and in 1872 they directed their Engineer to examine and report on the possibilities of deepening the approaches to the docks, and increasing the floating accommodation at the port. As a result of the Engineer's report, it was decided to seek Parliamentary powers for the construction of a new dock on the east side of the river, together with an entrance channel, and this work was authorised by an Act of 1874. Difficulties in obtaining capital were again experienced, and construction did not commence until 1879, after which swift progress was made. The old Port Tennant was incorporated in the eastern end of the dock, which was opened in 1881, by the then Prince of Wales (later King Edward VII) and named after him.

The total trade assumed proportions scarcely anticipated when the new dock was constructed, and plans were made to extend the dock and deepen the entrance channel. In 1894 powers were obtained for the enlargement and extension of the Prince of Wales Dock, and these works were completed in 1898.

The dimensions of the Prince of Wales Dock are as follows:—

Length of Dock	3,221-ft.
Width of Dock	508-ft.
Area of Dock	28 acres.
Lock (later filled in)	460-ft. x 59-ft. 6-in.

Together with the North and South Docks, the Prince of Wales Dock became crowded with traffic attracted to the port by the facilities offered, and after a comparatively short interval the Trustees realised that the congestion in the port and the rapid advance in the size of the vessels calling at Swansea were such that the undertaking would have to be extended still further. The Swansea Harbour Act of 1901 authorised the Trustees to borrow the sum of £2 million for the purpose of constructing a new dock, and in 1904 King Edward VII and Queen Alexandra visited Swansea, inaugurating the work upon the King's Dock by cutting the first sod.

The new dock was opened in 1909 by the Chairman of the Swansea Harbour Trust. It has an area of 70 acres, being 4,200-ft. long and 400-ft. wide, and is connected to the Prince of Wales Dock by a communication passage. Access from sea is by a lock 90-ft. wide and 875-ft. long.

During the construction of the King's Dock provision was made for a further extension to be completed at a later date, by building a breakwater on the southern side, and in 1920, Queen Mary opened the extension and named it Queen's Dock. The Queen's Dock was the last dock construction to be undertaken in South Wales, and its total water area is 104 acres.

In 1924 the Prince of Wales Lock Entrance was filled in, and the King's Dock Lock has since served the Queen's, King's and Prince of Wales Docks.

By this time the North Dock had become inadequate to deal with modern vessels and, under the Swansea North Dock (Abandonment) Act of 1928, the Dock was closed and later filled in. For many years coal had been brought from the Swansea Valley to this dock by barge via the Swansea Canal, and the closing of the dock brought about the cessation of commercial traffic on this waterway.

Administration.

One of the Acts of the Swansea Harbour Trust stipulated that for ten years after the opening of the King's Dock in 1909, the Corporation would guarantee any deficiency up to £150,000 in the total income of the Trustees after providing for all expenditure (including interest). Every year during that period the Trustees were obliged to look to the Corporation to make good a deficiency, so that by the end of the ten years the whole of the £150,000 had been absorbed. This was largely due to the First World War, which had the effect of reducing considerably the traffic of the port. Unlike the Railway-owned docks which were under Government control during the war and had their financial deficiencies adjusted by the Government, Swansea enjoyed no such support or control, with the result that the Trustees eventually found themselves with greatly depleted resources. The Great Western Railway Company who had, by amalgamation under the Railways Act of 1921, absorbed all the competing ports on the north side of the Bristol Channel, purchased the Swansea Dock undertaking in 1923, and the Harbour Trustees retired from their long years of voluntary service.

As a result of the passing of the Transport Act, 1947, Swansea Docks, in common with other railway owned docks in the country passed into public ownership, and are now administered by the Docks Board of Management of the British Transport Commission.

Industrial Development.

Copper. Until the latter part of the 19th Century Swansea was the chief copper smelting area of the world with a number of refineries in production. With the development of smelting in the countries producing the ore, however, the local industry gradually declined. The first copper works was built at Landore, and there to-day is the survivor of the industry—the manufacture of copper plates and sheets by Imperial Chemical Industries Limited.

Zinc. Several of the copper smelting works were converted for the smelting of zinc and the area is to-day one of the chief centres of the zinc industry in Great Britain. Zinc concentrates and iron pyrites are imported in large quantities through the docks, and passed to the works of the Imperial Smelting Company at Llansamlet. The products include not only metallic zinc, but also zinc oxide, and sulphuric acid, much of which is needed in the local tinplate works.

Tinplate. In 1867 Dr. Siemens experimented at Swansea and successfully developed steel suitable for the production of tinplates. Sulphuric acid, used for the cleaning of the plate, was available as a by-product of the local copper industry, whilst tin and iron ores could be imported through the docks. As a result the tinplate industry rapidly became one of the main contributors to the trade of the port, and to-day Swansea is the largest exporting centre in the world for tinplates, terneplates and blackplates. Between 1947 and 1951 the Steel Company of Wales Limited constructed new blast furnaces, strip mills and ancillary plant in the neighbourhood of Swansea at a cost of more than £100 million.

Nickel. Another thriving industry was established in 1900 by Dr. Ludwig Mond, who was attracted to the district by its reputation as a metal-refining centre. Clydach, approximately 6 miles up the Swansea Valley, was chosen as the site of the first nickel refinery, using the fuel gas produced from the local coal, and now the Mond Nickel Works are the largest refiners of nickel in the United Kingdom.

Considerable quantities of nickel-copper matte are imported through Swansea Docks, and the refined nickel is in constant demand from overseas markets, as well as from local metal indus-

The Port of Swansea—continued

tries. In addition the refinery produces nickel and cobalt oxides and salts, and various residues are passed to other refineries in the country, which in turn produce, gold, silver, lead, platinum and metals of the platinum group, palladium, rhodium, ruthernium and iridium.

Aluminium. Aluminium also has its place in Swansea's metal industry. There are large rolling mills at Waunarlwydd, Port Tennant and Resolven, and considerable tonnages of aluminium in its various forms are handled through the docks annually.

Coal. As already stated, the shipment of coal was established in the sixteenth century, but the quantities shipped were small until the construction of canals and railways, together with the development of the steam engine, resulted in the rapid expansion of the South Wales Coalfields. The coal trade was a prime factor in attracting shipping to the port, and was largely responsible for the continued development of the docks facilities, up to 1913, when a total of 4,530,000 tons was shipped from Swansea Docks alone. Despite the general recession in the export of South Wales coal since that date, Swansea has suffered less than the eastern ports of the Channel, owing to the continued overseas demand for anthracite, which is the type of coal mined in the area. The National Coal Board has in hand a £6 million scheme for the development of a new colliery in the vicinity, where the workable reserves are assessed at 134 million tons. Near Llanelly, to the west of Swansea, another new colliery is being developed at a cost of £7½ million.

Patent Fuel.

As a direct result of the coal trade, a works was established on the docks estate in 1912 for the manufacture of briquettes, which are exported in considerable quantities. It is now operated by the National Coal Board.

General Cargo.

In the early days, little general cargo was handled at the port, but the industrial development of the area caused a marked increase in the variety of goods handled, for which provision was made in the construction of the Prince of Wales and King's Docks, both of which are equipped with excellent general cargo berths. Following the outbreak of war in 1939, the diversion of vessels from the east coast ports tested the ability of the port to handle vast quantities of miscellaneous general cargo, and the success achieved is illustrated by the fact that no less than 24½ million tons passed through the port during the war period.

Tanker at No. 3 Jetty, Queens Dock, Swansea.

General cargo continues to be an important feature, and many Liner Conferences schedule regular services from Swansea to all ports of the world. The port facilities available for the handling of this class of traffic consist of 17 transit sheds with a total floor space of 750,000 square feet, and good road and rail connections serve deep water berths equipped with batteries of modern electric quayside cranes of up to six tons capacity. A hydraulic quayside crane of 70 tons capacity is available at King's Dock.

Fish. In 1904, Castle Steam Trawlers Limited, transferred their fleet of trawlers from Milford Haven to the South Dock, Swansea, where a wholesale fish market was established. The fishing industry flourished and in 1918 Consolidated Fisheries Limited took over the Castle Steam Trawlers. Following the Second World War, the Industry suffered a serious decline, and the deep sea trawlers ceased to operate from Swansea in 1956, leaving only a small number of in-shore fishermen based on the port.

Oil. In 1922, two years after the opening of the Queen's Dock, National Oil Refineries Limited, a subsidiary of the Anglo-Iranian Oil Company Limited, leased from the Harbour Trustees an area of reclaimed land at Queen's Dock for the erection of a tank farm together with the necessary pumping equipment for the reception of oil from tankers berthed in the Queen's Dock.

Aerial view of Swansea Docks.

Pipelines were laid from the dockside installation to the Oil Company's refinery near Skewen, a distance of approximately four miles. This was the first major oil refinery to be built in the United Kingdom, and by 1927 Swansea had become the chief petroleum port of the country, with an annual importation of more than one million tons of crude oil. A new village to house the labour employed in the refinery was built and named "Llandarcy," after Mr. W. K. D'Arcy, a founder of the Anglo-Iranian Oil Company.

With the rapid development of oil-burning vessels in the early 1920's, the oil bunkering facilities available obviated the necessity for such vessels to go as far up the Channel as Avonmouth to refuel.

The Queen's Dock has been used exclusively for oil traffic (apart from facilities for repairing vessels afloat) and in 1949 a second and larger distillation unit came into operation at Llandarcy. Crude oil is pumped from the docks to the refinery by multiple pipelines, and much of the refined product, and also by-products are returned to the port for shipment.

The closing of the British refinery at Abadan in 1951, meant that the output of the remaining refineries had to be stepped up to meet the demand for oil, and this

The Port of Swansea—continued

resulted in the tonnage of oil of all types passing through Swansea during 1952 reaching a record total of more than eight million tons.

Ocean tankers are accommodated at five new concrete jetties on the south side of the dock, with three lay-by berths on the north side. In 1956, a further new jetty, 600-ft. long was constructed on the north side, for the loading of coastal tankers with refined oil.

A post-war addition to the port's oil facilities has been the establishment of a tank farm on the river bank by the Regent Oil Company, at which coastal tankers are dealt with.

Latex. In 1950, the Dunlop Rubber Company erected a tank farm at the King's Dock, with a capacity of 60,000 gallons, to deal with the importation of Latex liquid rubber. The latex, which is imported from Malaya, is processed at the Dunlopillo factory at Hirwaun, approximately 20 miles inland from the port, for the manufacture of car cushions, mattresses, pillows, etc.

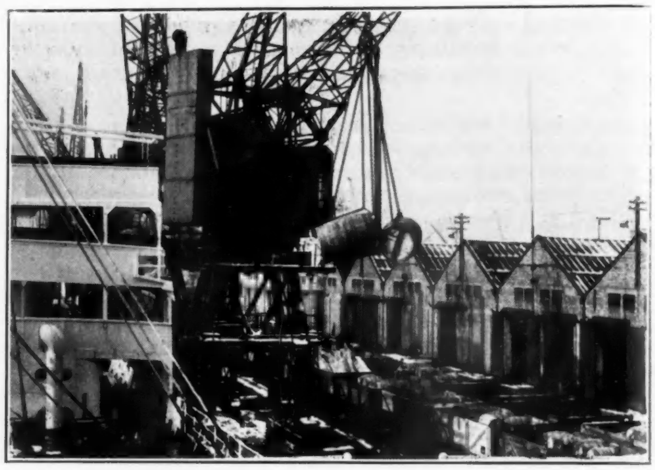
The Port To-day.

By the end of the Second World War, certain machinery and plant had reached the end of its serviceable life, in particular the pumps supplying the hydraulic power for coal hoists, lock gate machinery, swingbridges, sluices, cranes, etc. This pumping machinery, which was steam-operated, had been installed about fifty years, and apart from its worn condition, operating costs were uneconomic. It was therefore decided to replace it by new electrically-operated plant.

Before the new pumping machinery could be installed, it was necessary to modernise the whole electrical system at the port and the scheme, which is now virtually completed, included the reorganisation of the electrical services at the South Dock, a new Ring Main and the reorganisation of the low-tension service at the King's and Prince of Wales Docks, as well as the installation of electrically-driven turbo-pumps to replace the steam plant for hydraulic power and impounding at the three power stations serving the port.

The bridges, lock gates, crane tracks, etc., have undergone an extensive repair and maintenance programme by the Civil Engineer's Department, and the 9½ miles of roadway, originally constructed with granite setts, have all been replaced either by concrete or tarmacadam. In addition, 138 miles of railway track are maintained. A heavy programme of building work has been carried out, including the renovation of power stations to accommodate the new machinery, and in the case of one of the power stations, the erection of a new building. Transit sheds have been repaired and maintained, and minor buildings such as messrooms erected.

A major scheme has been embarked upon by the British Transport Commission with the object of increasing locking capacity and ensuring, as far as possible, that the dock system is capable not only of dealing expeditiously with the volume of trade at present using the port, but also to cater for the future. For some time the tendency has been towards larger vessels of deeper drafts, and the works now in hand will make possible the retention of a depth of 33-ft. of water in dock, as well as enabling more ships to pass through the King's Dock Lock on each tide.



Discharging nickel copper matte at Swansea Docks.

Loading cargo at "F" Shed, King's Dock, Swansea

The works include the provision of a new approach jetty outside the lock entrance, at which vessels may lay waiting turn to dock; the extension of the existing riverside roundhead and the deepening of the entrance mouth to enable large shipping to swing in the entrance; the installation of a new pumping system, comprising two large pumps, each of 100,000 gallons per minute capacity, with ancillary works such as suction and discharge culverts, new pumphouse, etc.

Dredging.

With the fast flowing tides of the Bristol Channel, there is a considerable movement of sand and silt over the bed of Swansea Bay, and in order to maintain the entrance channel to the King's Dock entrance, considerable dredging has to be carried out throughout the mile-long approach channel, the volume of spoil removed annually being approximately one million cubic yards.

Although the port is well sheltered from the full force of the prevailing westerly air stream by the Gower Peninsular and Mumbles Head, the short seas and ground swell in the bay render conditions for dredging difficult in times of severe weather, and to meet these conditions, two bucket dredgers of the self-propelling type are employed.

Each of the two dredgers has an output approaching 1,000 cubic yards hourly. The "Abertawe" which was built in 1947, is a twin-screw bucket dredger, with a separate engine for the belt drive to the top tumbler. The craft is capable of dredging to a depth of 48-ft., and has 44 dredging buckets each of 27 cubic feet capacity. The other channel dredger, the "David Davies," an older craft, is also a twin-screw hopper dredger, the drive to the top tumbler being by gearing. An adequate number of steam hoppers of up to 900 cubic yards capacity and of modern design act as carriers. V.H.F. wireless communication is provided between ship and shore.

Dredging work in dock, largely confined to clearance of quay-side berths, is carried out by steam grab dredgers.

As in the case of Cardiff, and indeed all the South Wales ports, because of the considerable range of tide, dredging is carried out on a day and night tidal basis, which necessitates the provision of suitable modern accommodation for the crews living aboard.

No dock system can function efficiently without ship repairing facilities, and Swansea is not lacking in this respect. The Prince of Wales Dry Dock Co. (Swansea) Limited operate two dry docks: the Prince of Wales, 455-ft. long and 60-ft. wide, entered from the River Tawe, and Palmers' Dry Dock, 560-ft. long by 75-ft. wide,

(Concluded at foot of following page)

New Pier for Port of San Francisco

Reconstruction of Piers Nos. 15/17

(Specially Contributed)

For the modernisation and combination of piers 15 and 17 at the Port of San Francisco more than 2,000 pretensioned concrete piles were used as underpinning. The piles formed the foundation for an asphalt-surfaced loading deck which links the piers. The combined area of the two 800-ft. long piers and 190-ft. wide deck is almost 10 acres, thus providing plenty of room for the handling of cargoes.

An increase in the size of the transit sheds brings the total floor area to more than ¼ million square feet.

The piles were fabricated at a yard 50 miles away, and transhipped by barge to the construction site; the timber piles used were brought by raft from a point 15 miles away.

About 140 of the piles were 131½-ft. long, which is believed to be a record. The remaining units were of composite construction, the top 23 to 30-ft. being of prestressed concrete and the lower part of timber, measuring in some cases as much as 104-ft.

The long piles have a diameter of 20-in. and are octagonal in shape. To save weight for handling purposes, the units have an 11-in. diameter hollow core, except for 4-ft. of the tip and 4½-ft. of the butt, which are solid.

Prestressing was accomplished by 18 high-strength, stress-relieved wire cable strands of ⅜-in. nominal diameter in each pile, each strand consisting of seven wires.

The prestressed part of the composite piles has a 14-in. octagonal section of solid concrete, and 11 strands are used. The lower end of the concrete portion is cast into a 13-in. (interior diameter), ¼-in. thick pipe connector for the purpose of providing a splice for the timber section. The pipe is 4-ft. long, lapping 2-ft. over the concrete and 2-ft. over the timber pile.

Although the truck loading deck (3½-ft. lower than the floor level of the pier) cuts the piers' available berthing capacity from four to three ships, it provides more room for handling cargoes. The arrangement has the advantage of cutting the handling time of ships by an average of one day. The system also keeps trucks off the previously congested waterfront street.

In addition to the road transport facilities, the deck between piers also features a pair of railway spurs, one on each side, for easier rail loading.

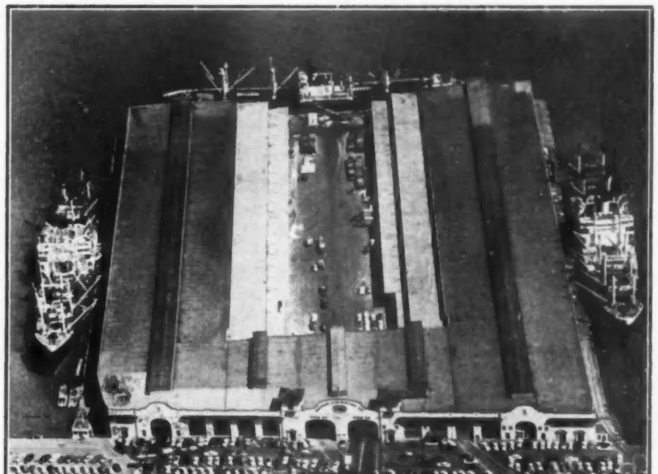
The entire scheme is similar to the work on piers 30 and 32 which was completed in 1951. The conversion of piers 15 and 17 was finished early last year.

The major problem faced by the engineers of the Board of State Harbour Commissioners was selecting the most suitable type of pile to support the beam and slab concrete deck. To capitalize on the economy of timber piles, the engineers decided upon filling the slip with mud. To hold the fill material in place, a 30-ft. deep underwater rock dyke was built near the offshore end of the slip at a cost of 59,000 dollars.

The imported fill material was brought up to within 6-ft. of the water's surface, leaving enough room for floating pile driving equipment. This made possible the use of composite piles on most of the work, a total of 1,840 piles being driven. To allow for future consolidation, the concrete portions of the piles are driven 10-ft. into the mud.

Being below the surface of the mud, the timber piling will not be affected by marine borers, and in addition the extra lateral support given by the filling enabled the designers to specify piles of smaller diameter. In spite of this additional protection however alternate tenders were invited on three types of piles, viz.: timber with gunite-jacketed tops, precast concrete and also prestressed concrete timber composition. The last type proved the least costly.

As it was feared that timber piles could not successfully penetrate the rock dyke, full length concrete piles were specified in that



Pier 30-32, one of two major Port of San Francisco terminals formed by combining two former finger piers, berths three vessels, and is similar to the newly completed Pier 15-17.

area. There, too, alternate tenders were invited. The choice was between ordinary precast concrete and prestressed concrete. The last type again proved the least costly.

Prestressing.

The contractors for the major part of the work were Ben G. Gerwick, Inc. who established a 500-ft. long, four-line pretensioning bed at the construction yard in April 1955. Productive capacity was increased two months later by the addition of a 340-ft., 3-line bed. Strand reels, each holding 15,000-ft. of strand, were mounted on spindles at one end of each bed. The strands were pulled the entire length of the bed in one smooth operation, then anchored in distribution plates. When securely anchored, the strands were tensioned by a 200-ton hydraulic jack up to 175,000 psi. (70 per cent. of the ultimate strand strength). With the design load estimated at 11,200 pounds, each strand was loaded to 14,000 pounds (or 175,000 psi.) to allow for the relaxation of stress through creep and plastic flow. The ultimate strength of the steel is 270,000 psi.

Concrete.

The concrete design called for a 28-day strength of 5,000 psi.

The Port of Swansea—continued

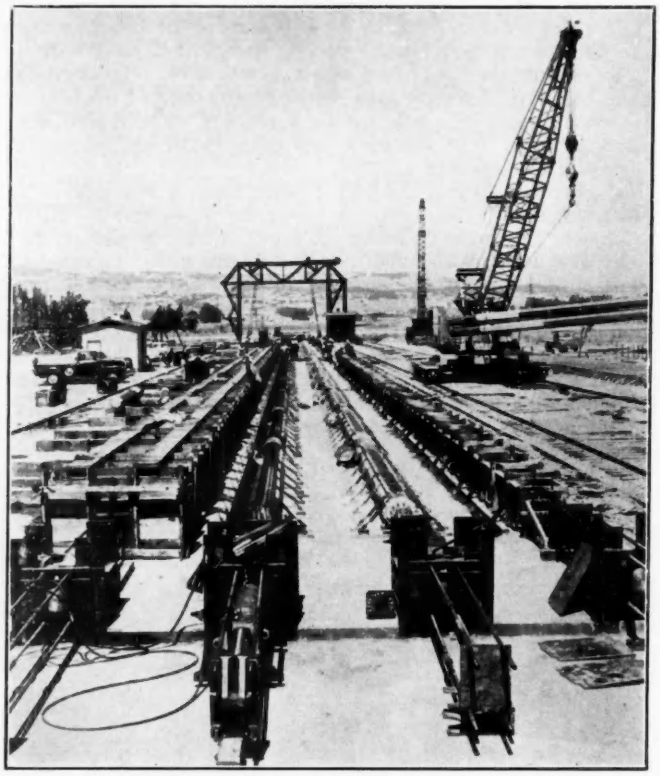
entered from the King's Dock. Work is shortly to be commenced on the construction of a new dry dock alongside Palmers' dry dock. The firm also are constructing a new repair berth 500-ft. long on the north side of the Queen's Dock, which will be used for repairs afloat in addition to their repair jetty. 760-ft. long, in the Queen's Dock. Consolidated Fisheries Ltd. operate a dry dock 370-ft. long by 60-ft. wide in the South Dock, and on the western side of the river is the Swansea Corporation's Cambrian Dry Dock, 263-ft. long and 41½-ft. wide, which is leased to General Engineering (Swansea) Limited.

All these dry docks are maintained in a high state of efficiency, with modern workshops and up-to-date equipment. Tank-cleaning and gas-freeing plant is available for the oil tankers using the port.

The British Transport Commission have purchased new electric quayside cranes and diesel-operated mobile cranes, as well as mechanical handling appliances which include a fleet of calf dozers for use when discharging bulk cargoes such as zinc concentrates, iron pyrites, etc. Four of the quayside cranes are being fitted with electro magnets to expedite the discharge of scrap iron cargoes. A fifty-ton capacity floating crane is based on the port, and a hundred-ton floating crane owned by the British Transport Commission and based on the South Wales Ports is made available at Swansea as and when required.

Swansea is the centre of a vast and thriving industrial area, and it is the policy of the Port Authority to afford ample and efficient dock facilities to meet all requirements and ensure the speedy turnround of shipping.

New Pier for Port of San Francisco—continued



Pile casting yard. Although 50 miles from Piers 15 and 17 across the bay of San Francisco, the yard is located on a creek and the use of barges proved an easy method of transportation.

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The actual 28-day strength varied from 6,000 to 7,000 psi. with at least 4,000 psi. obtained by the steam cure. Piles were driven in some cases three or four days after casting.

Concrete supplied from a nearby yard was poured into the forms at the rate of about 10 cubic yards an hour. Internal vibration helped compaction and produced a smooth surface.

When the concrete had been poured and the top side of the octagonal pile was finished, steam hoods were lifted into place with a crane and fastened tightly over the full length of the bed. The piles were then steam heated at 140 degrees for 24 hours and air cured for an additional 16 hours.

After the steam hoods and forms had been removed, the tension on the strands was released uniformly. Between each pile the strands were cut by acetylene torch within 24 inches of the piles. The surplus steel facilitated tying into the cast slab deck. In full production, 16 piles measuring 23 to 28-ft. in length were manufactured daily.

Pile Handling and Driving.

At the construction site, the shorter piles were removed from the barge by a two-point lift, while the 131-ft. piles required a four-point lift.

Handling the short concrete portions of the composite piles was effected easily with a two-point lift. Some difficulty was experienced with larger 131-ft. piles because, although they had hollow cores, they weighed $16\frac{1}{2}$ tons each.

The contractors were helped in the problem of lift points by a graphical method of analysis developed by the senior harbour engineer for the Board of State Harbour Commissioners. His analysis, included in the specifications, was based on a rigorous mathematical study of the stresses involved in lifting the long piles with six or fewer lift points and no trouble was experienced in moving the prestressed piles by a four-point lift.

Lift points were located $9\frac{1}{2}$-ft. from each end and at two other points 36-ft. farther in. This left a 41-ft. space in the centre. Two slings, 60-ft. in length, of $1\frac{3}{4}$-in. cable connected the two end points. Slings were threaded through running blocks connected to lift lines, each of which was powered by a separate winch on the pile-driving rig.

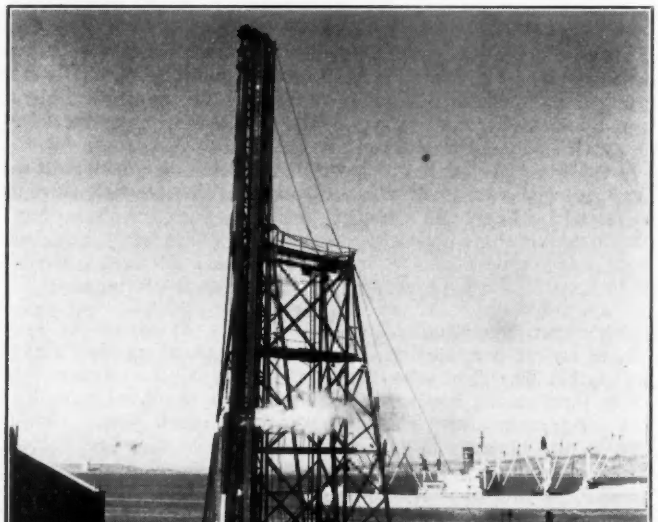
The piles were driven by a 32,500-ft. pounds hammer floating rig, with 120-ft. leads, to pre-determined elevations, because levels of the sand and gravel strata were known with some accuracy. Records had been kept from the time when piers 15 and 17 were first built. As a double check a line of test piers was driven down the centre of the slip.

For the 1,839 composite piles, a 30-ton bearing capacity was required. Only 38 of these piles had to be driven below the set elevation, and 26 of the piles reached the bearing strength above the predetermined elevation. A tolerance of plus or minus three inches occurred.

All of the long prestressed piles were driven to predetermined grade, where they developed 60-70 tons safe bearing capacity as compared with the design load of about 50 tons. Driving rate for the long piles varied from five to nine per eight hour shift.

The pile bents are spaced on 10-ft. centres. Composite piles are spaced $5\frac{3}{4}$-ft. to 10-ft. in the bent. Spacing of the long piles is 10-ft. within the bent, except for the last two bents, where the spacing is 12-ft.

The formwork rests on 6 x 12-in. girts, which in turn rest on 6 x 12-in. blocks tightened together around each pile with 1-in. bolts.



Nearing completion of its job, a pile-driving rig works near the end of the slip during the project of linking Piers 15 and 17 with a 190-ft. wide concrete slab deck.

New Pier for Port of San Francisco—continued

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Some of the composite piles were driven in 10 minutes. An average of 16 piles per day were driven, and of these only one or two required cutting.

Pier Superstructure.

For the deck slab, ready-mixed concrete was layed via two conveyor belts fitted with elephant trunks. Pouring took place once weekly close behind the driving operation and roughly 210 cubic yards of concrete was use in a section of deck measuring 30-ft. x 200-ft.

Form removal was quickly effected by workers floating in under the deck on rafts at low tide and loosening the 1-in. bolts which lamped the 6 x 12-in. blocks to the piles. This permitted the plywood sections to drop into the water and be floated out and be quickly lifted into place for the next pouring operation.

A 1½-in. asphalt surface capped the concrete deck. The transit sheds covering the piers, of which one is of steel framed construction and the other of timber, were enlarged by removing a wall from each and extending the covered area by 43-ft. per shed. The berthing length on the offshore end of the combined pier is 486-ft. These and other separate contracts brought the cost total to two million dollars.

Organisation of Work.

The design and construction supervision of the work was handled by S. S. Gorman, chief engineer for the Board of State Harbour Commissioners.

Valuable aid in determining the specifications of the prestressed pilings was available as a result of special lightweight piling tests conducted by the Division of Bay Toll Crossings, California Department of Public Works, who plan to construct a new bridge across the southern end of San Francisco Bay, and needed corroborative data on the desirability of lightweight piles.

The Division's test pile was 132-ft. long and made of 105 pcf. concrete. At grade elevation, the pile was being driven by 35 blows per foot with a 32,500-pound hammer, equivalent to a 162-ton bearing capacity. Slight spalling took place at the head of the lightweight pile, but in view of the unusually severe driving, the spalling was not considered serious. The heads of the regularly prestressed concrete piles were in excellent condition after driving.

In the execution of this work, two State agencies, a corps of engineers and a number of contractors have worked together to produce one of the most up to date facilities at the Port of San Francisco. The Board of State Harbour Commissioners believes that this type of progress will encourage larger shipments of commodities between Europe and the West Coast of the United States.

An indication of this expanding commerce is shown by the trade with the United Kingdom for 1955. Exports from the Port of San Francisco totalled over 76,000 short tons and imports totalled 35,000 tons. The figures for 1956 indicate that these totals are steadily increasing.

Whitstable Harbour

Review of Proposed Improvements

By CYRIL RUSSELL

The steady dilapidation of the quays and the silting up of Whitstable Harbour has, in recent years, been a constant source of worry for those more closely connected with the harbour. In the not too distant future, however, the plight of the harbour is likely to be relieved, and a new lease of life given to it. Subject to a Bill in Parliament the ownership is to pass from the British Transport Commission to the local Council, who intend to see that the necessary remedial works are put in hand.

Whitstable Harbour was constructed in 1832, for the Canterbury and District Railway Company at a cost of £10,000; a figure, which did not include the purchase of the land or the subsequent construction of a reservoir used for flushing the harbour free of silt. The harbour was at the time described as "large and commodious."

The ownership of the harbour and of the railway was vested successively in the South Eastern Railway Company, the Southern Railway Company and the British Transport Commission. The railway ceased to function as such in 1953 and since the taking up of the lines in the same year, the harbour has been without rail communication of any kind.

Lack of maintenance in the harbour during the second World War and the difficulties of undertaking work in the years immediately following were the main factors causing the present dilapidation. The Railway Executive being confronted with the need of spending all possible money on rail re-organisation have passed over the needs of the harbour now completely divorced from rail communications. This has resulted in the almost complete closure of the East Quay and in the partial closure from time to time of other quays.

Many organisations campaigned for action by the Railway Executive, and the local Council pressed the matter with various Government Departments, only to receive the repeated answer that there were other matters of greater importance. Having decided that if nothing was done the situation would worsen, and believing that the preservation of the harbour, its trade and its further development, to be matters of importance to the interests of Whitstable the Council decided to consider the possibility of acquiring the harbour and undertaking the work themselves.

Negotiations proceeded for a year and following a careful study of constructional and financial reports, including a statement of several years income and expenditure of the harbour under British Transport ownership, the Whitstable Urban District Council

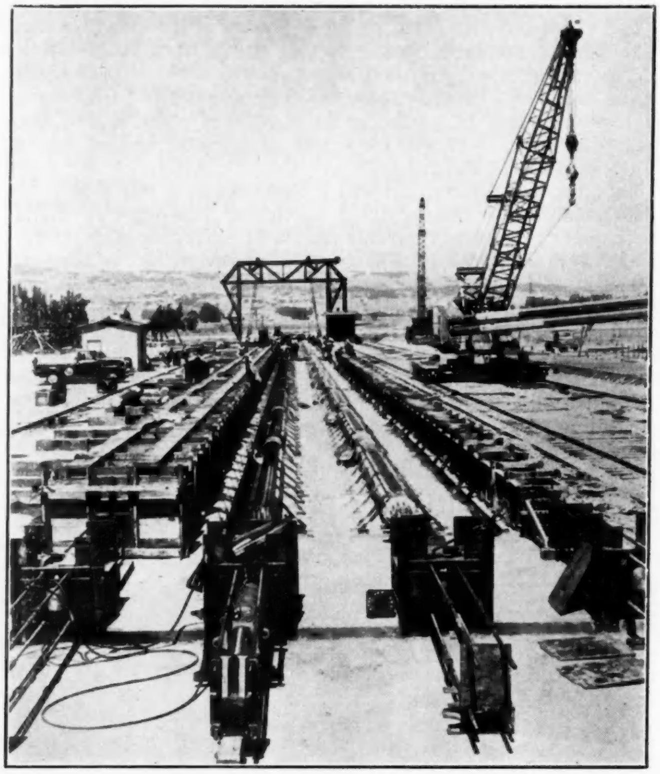
View of Whitstable Harbour basin with grain silo in centre.

decided to agree a compromise figure of £12,500 for the purchase of the harbour and harbour estates. This figure, although considerably less than the original price put forward by the British Transport Commission, has been accepted, and the Council have deposited a Bill in the 1956-57 Session of Parliament to secure the necessary powers for the borrowing of money, the purchasing and administration of the harbour and the surrounding estate.

With the depositing of a Bill in Parliament it is a Statutory Requirement that a public meeting be held for the electors to express their opinion and pass or reject the promotion of the Bill. In the case of Whitstable Harbour, the Bill was deposited in Parliament on the 27th November 1956, and the public meeting was held on the 20th December 1956.

Over 400 people attended the meeting and some very forthright opinions were expressed both for and against the proposals contained in the Bill. Some of the points raised by speakers against the proposition were: that the meeting was held too early, leaving little time to investigate the insufficient facts that were disclosed;

New Pier for Port of San Francisco—continued



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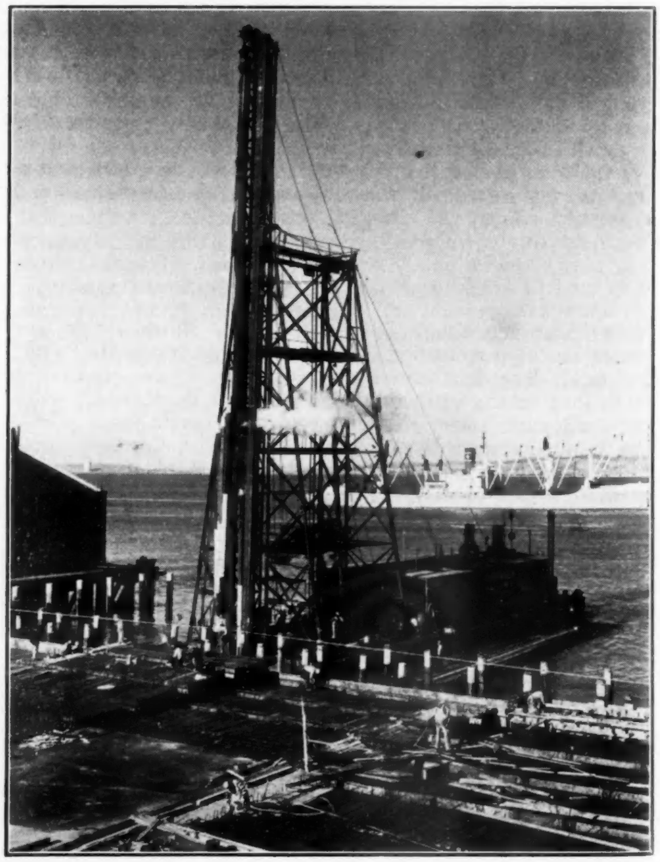

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The ownership of the harbour and of the railway was vested successively in the South Eastern Railway Company, the Southern Railway Company and the British Transport Commission. The railway ceased to function as such in 1953 and since the taking up of the lines in the same year, the harbour has been without rail communication of any kind.

Lack of maintenance in the harbour during the second World War and the difficulties of undertaking work in the years immediately following were the main factors causing the present dilapidation. The Railway Executive being confronted with the need of spending all possible money on rail re-organisation have passed over the needs of the harbour now completely divorced from rail communications. This has resulted in the almost complete closure of the East Quay and in the partial closure from time to time of other quays.

Many organisations campaigned for action by the Railway Executive, and the local Council pressed the matter with various Government Departments, only to receive the repeated answer that there were other matters of greater importance. Having decided that if nothing was done the situation would worsen, and believing that the preservation of the harbour, its trade and its further development, to be matters of importance to the interests of Whitstable the Council decided to consider the possibility of acquiring the harbour and undertaking the work themselves.

Negotiations proceeded for a year and following a careful study of constructional and financial reports, including a statement of several years income and expenditure of the harbour under British Transport ownership, the Whitstable Urban District Council

View of Whitstable Harbour basin with grain silo in centre.

decided to agree a compromise figure of £12,500 for the purchase of the harbour and harbour estates. This figure, although considerably less than the original price put forward by the British Transport Commission, has been accepted, and the Council have deposited a Bill in the 1956-57 Session of Parliament to secure the necessary powers for the borrowing of money, the purchasing and administration of the harbour and the surrounding estate.

With the depositing of a Bill in Parliament it is a Statutory Requirement that a public meeting be held for the electors to express their opinion and pass or reject the promotion of the Bill. In the case of Whitstable Harbour, the Bill was deposited in Parliament on the 27th November 1956, and the public meeting was held on the 20th December 1956.

Over 400 people attended the meeting and some very forthright opinions were expressed both for and against the proposals contained in the Bill. Some of the points raised by speakers against the proposition were: that the meeting was held too early, leaving little time to investigate the insufficient facts that were disclosed;

Whitstable Harbour— *continued*

that Whitstable already had a debt of £800,000 and the more pressing problems of Sewerage, Roads and Lighting should take precedence over the harbour purchase; that the financial calculations allowed no contingencies and any disaster such as a flood, similar to the one experienced in 1953, could ruin Whitstable financially; what would be the future of Whitstable Harbour when the United Kingdom Chamber of Shipping had reported a 53% decline in shipping under 1,500 tons in recent years.

The Clerk to the Whitstable Council, in answering the critics brought out some very important points: that the 36 fishing boats at present working from the harbour made an annual fish landing valued at £160,000; the value of the boats engaged in fishing is £42,000 and repairs to these boats in Whitstable shipyards had been in the region of £34,000; that the vested power in the Transport Commission was " to alter, repair, or discontinue," and should they decide to close the harbour nobody had the power to stop them; of the £800,000 debt which Whitstable has, 80% is vested in Council Houses, and nobody would dispute their value to the community; to the people who were concerned with a rise in rates, he asked: " Who will hazard a guess at the rise in rates if the harbour is left to collapse and the deriliction spreads to the town, as it surely must?"

After three hours of discussion the resolution was voted upon and passed, the majority being approximately three to one, but the persons who still doubted the wisdom of the purchase obtained the

Entrance to Whitstable Harbour looking seawards from the basin. East Quay (which is almost completely closed) is on the right.

necessary signatures to force a referendum. Only 30 per cent. of the electorate availed themselves of the poll, which cost the town some hundreds of pounds and produced a two-thirds majority in favour of the purchase.

With the main steps towards the purchase having been taken the matter now rests with Parliament, but it will be at least another year before any constructional works are commenced.

Rehabilitation Works Required.

The necessary remedial works suggested to put the harbour in first-class working order are considered in two stages, those of first and second priority. Works of first priority comprise the reconstruction or repair of quays and breastworks which are considered to be in a dangerous condition or to be so far advanced in decay that their reconstruction could not safely be postponed if the harbour is to remain operational. They include the complete reconstruction of parts of the South Quay.

Matters of second priority comprise works of varying urgency depending upon the purpose for which the harbour is used and the rate at which further deterioration takes place. They include the reconstruction of the West side of the Entrance and the remainder of the East and South Quays; the renewal of timber fenders; alteration to the existing sea defences; and the provision of paved areas along all quays.

The Harbour was originally dredged to give a depth of 15-ft. of water at High Water Spring Tides and of 12-ft. at Neap Tides. Severe siltation has occurred over recent years and to regain these depths it will be necessary to dredge 9,500 cu. yds. of spoil and this work is included in the second priority plan. Dredging has previously been carried out every 10 years, the last time being in 194[illegible]. The cleaning of the reservoir which flushes the harbour is not anticipated for another 25 years, as it has in the past been cleaned approximately every 30 years, and was last undertaken in 1950.

Depth of water is an important factor in the Harbour's future, but local users feel that the bigger boats now becoming more popular are having to conform to the draught of the previous smaller ones. The draught for boats which, from time to time, come into Whitstable and are of relatively modern construction, include 350 tonners drawing 9-ft. 6-in., 800 tonners drawing 11-ft. 6-in., and 1,200 tonners, such as used the east quay before it was damaged, drawing 12-ft. 6-in. One Harbour user has stated that if the east quay is put in order he proposes to bring in boats of up to 1,500 tons capacity, which would be able to work on the draught provided.

The consulting engineers' estimates of the Capital works required amount to £72,000, and since the date these were made costs have risen by approximately 5 per cent. and will probably continue to do so for some years ahead. The cost of the capital works together with the Purchase price and the Cost of the Parliamentary Bill will be spread over a number of years and the financial effect will vary with the carrying out of the first and second priority works. It is anticipated that it will be five years before any deficiency will have to be met by the rates and then the probable rate impact is likely to be 1½d. in the £.

Although the Chamber of Shipping and other Harbour Associations forsee that there will always be coastal shipping to trade with the smaller ports, only the future can show whether Whitstable Harbour can attract the trade it needs for the proposed improvements to be an economic proposition.

Improvement Works at Bridgetown

The Barbados Government have awarded a contract worth more than £3,600,000 to Richard Costain Ltd. for the construction of a deep water harbour at Bridgetown. The contract, which was open to international tender, will be completed in about four years.

At the present time at Bridgetown there is only a small basin for shallow draught vessels, and larger vessels have to anchor outside the careenage and offload their cargoes into lighters.

The construction of some parts of the harbour including the main quay wall will be somewhat similar to the Apapa Wharf which is now being completed in Nigeria, but there will be, in addition, a large breakwater to form a protection from the open sea.

The reclamation area for roads, stacking and warehouses will be behind the 1,211-ft. long wharf wall. This reclamation will extend to the shore and will be contained at the north and south ends by rubble banks 1,700-ft. and 2,600-ft. long respectively. Between the wharf wall and the protection of the breakwater there will be a 500-ft. inner berth of reinforced concrete but the quay wall and the breakwater are to be constructed of sliced blockwork and will comprise of some 25,000 blocks ranging between 15 and 26 tons. The breakwater extends for 1,000-ft. in a westerly direction and then 1,700-ft. to the north, and is open only at the north end. In addition to the main quay wall and the inner berth the first part of the breakwater will be used as a bulk sugar loading berth.

There is no large quarry established on the island but one will be opened. The nature of the stone is coral limestone and the quantity required for the works is about half a million tons, of which one half will be crushed for concrete.

The consulting engineers are Coode and Partners and Blankvoort and Zoon of Holland will be working in conjunction with Costains on the dredging, which will involve the removal of one million cubic yards of spoil.

Electrical Distribution as applied to Docks

Section V. System Protective Devices

By C. H. NICHOLSON, M.I.E.E., M.I.Mech.E., F.R.S.A.

(Continued from page 407)

An electrical distribution system being subject to faults and overloads requires some form of protection to prevent damage to plant, cables, etc., and also it is very desirable that any form of protection adopted should isolate the circuit which is involved only, and further, transient excess currents due to overloads, etc., should not cause interruption of the electricity supply. A relatively simple example of the necessity for the operational discrimination of fault protection apparatus is the case of two parallel connected feeders supplying say a distribution pillar from a substation, normally if the feeders are merely protected for instance by fuses, a fault on one feeder is fed into by both cables and hence both feeders are isolated by fuse operation and the entire supply to the distribution pillar is disconnected.

Fig. 5.1 illustrates the use of reverse current devices at the distribution pillar end to ensure that power at all times flows into, and not out of, the pillar busbars and thus prevents feed back from the pillar busbars into the fault. Similarly, the case of transient currents is dealt with by devices which have either an inverse time limit characteristic, or two relays, one having a definite time delay and one with an instantaneous setting. The inverse time characteristic is shown on Table 5.1 from which it is seen that although for a period of 6 seconds the overcurrent capacity is 200% of full load, the overcurrent which will cause operation of the device in 2 seconds is 1,000% of full load which allows currents equivalent to 1,000% of full load to be maintained without interruption for 2 seconds. The two part definite time delay may be arranged to allow 300% of full load current for 2 seconds, whilst operating on 125% of full load current at the expiration of 2 seconds, both current and time values being separately adjustable.

Table 5.1 Inverse Time Characteristic. Induction Type Relays.

Percentage of loadsetting	Time of operation in seconds	Percentage of loadsetting	Time of operation in seconds
100%	inoperative	600%	2.4
200%	6	700%	2.25
300%	4	800%	2.2
400%	3.2	900%	2.1
500%	2.75	1,000%	2.0

In the above table the definite minimum time delay is 2 seconds.

The types of protection available are:—
(1) Overcurrent (or overload)
(2) Reverse current
(3) Earth leakage
(4) Low voltage
(5) Excess voltage

The most widely used is overcurrent protection, which, as dealt with in section VII on Earthing, is often used in the dual capacity of providing protection against both overload and earth leakage. Overcurrent protection may be effected by means of fuses or circuit breakers, these being fully dealt with in Section IV on Switchgear. Fuses, automatically give an inverse time/current characteristic as shown in Table 5.2 and thus provide a reasonable measure of normal overcurrent protection, whilst allowing high transient currents, due for instance to the starting up of motors, or fault clearance on low capacity circuits.

Grading of overcurrent protection is possible by the use of fuses of different ratings, providing close discrimination is not required, thus, ten-10 ampere fused circuits supplied from busbars protected by a 100 ampere fuse will have the necessary discrimination to ensure that the operation of a 10 ampere fuse under fault conditions will not cause interruption to the remaining circuits. Another method of obtaining discrimination is by grading the time delay with or without overcurrent grading, this method being used where circuit breakers are installed. The disadvantage of this method is the rather large time lag which is introduced if the number of substations is large, which reduces the fault current carry capacity of cables, busbars, current transformers, etc. It may be that the supply Authority prescribes a relatively short period for the maximum time delay permitted, which again restricts the use of this method. Time delay, which is of course the time in seconds after the incidence of the overload required by the circuit interrupting device to operate, may be obtained in the case of circuit breakers by means of mechanical, eddy current, capacitor/resistor operated devices or by induction type relays. The most widely used is probably the dashpot which merely consists of a piston which may be provided with an adjustable orifice, moving in a cylinder filled with oil or in the case of the air dashpot, air. Either device suffers from the defect of inaccuracy due, in the oil dashpot, to incorrect grades of oil being utilised and also to changes in temperature causing a change in oil viscosity, a typical case, using an oil having the minimum change in viscosity with temperature, is, time delay at 76°F. 2.3 seconds at 45°F. 5.4 seconds. The air dashpot suffers from changes in time delay due to piston and cylinder wear, inclusion of dirt and dust. Either device is relatively cheap hence the universal adoption but as indicated above has not stable calibration, the characteristic being inverse time/current. Mechanical devices in the form of what is virtually a watch escapement of robust design are much more satisfactory having an inverse time/current characteristic and if suitably enclosed will give long service. The induction disc type of relay is although relatively expensive a very satisfactory method of obtaining a time delay of inverse time/current characteristic which is adjustable within fine limits and is widely used for important circuits (Table 5.1). The capacitor time delay device is somewhat cheaper than the induction type relay and gives a definite time delay which is constant and independent of current adjustable within fine limits, is devoid of moving parts, is of high permanent accuracy, and when used in conjunction with an instantaneously operated device giving combined time delay and instantaneous protection very close grading is possible.

Table 5.2 Inverse Time Characteristics H.R.C. fuse (300 ampere).

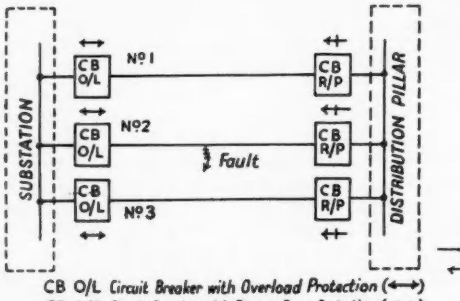
Percentage of Full load (of rated fuse capacity)	Time of operation in seconds.
100%	inoperative
180%	6,000
210%	600
280%	60
400%	6
700%	.6
1,000%	.06

Reverse current protection is necessary where there is a possibility of current flow into faults through healthy cables, L.V. current flow into transformers, etc., a typical case of the former being the two parallel feeders previously cited, the latter case of the transformers being where two transformers are feeding common busbars and one transformer is switched out on the H.V. side, this being now fed from the L.V. side supplied by the transformer remaining in circuit on the H.V. side. This condition can and generally is prevented also by electrically interlocking the H.V. and L.V. circuit breakers so that opening the H.V. circuit breaker automatically opens the L.V. circuit breaker. The use of directional relays with time grading in connection with the protection of a ring main is illustrated in Fig. 5.2.

Earth leakage protection may be either of the differential or direct series type, the former being the most widely used, the latter being reserved for protecting relatively small plant, apparatus, and portable tools.

All differential earth leakage systems operate upon the basic principle that in a three phase balanced system the algebraic sum of the currents at any instant is zero, hence if current transformers are so connected to summate the currents in the three phases, the resulting secondary current will be zero if all phases are balanced,

Electrical Distribution as applied to Docks—*continued*



CB O/L *Circuit Breaker with Overload Protection* (⟷)
CB R/P *Circuit Breaker with Reverse Power Protection* (→←)
Fig 5·1- Parallel Feeders

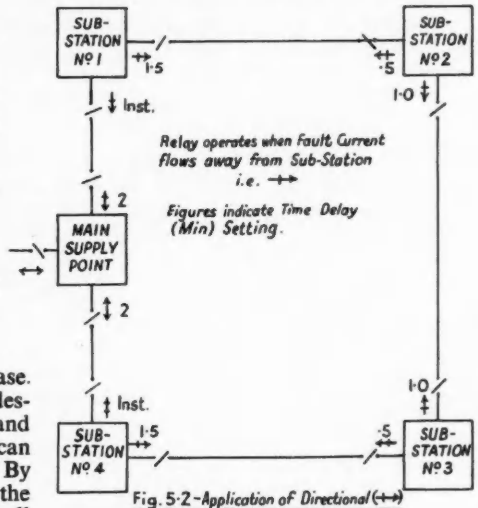


Fig. 5·2-Application of Directional (→←) & Non-Directional Relays (⟷) to Ring Main Protection

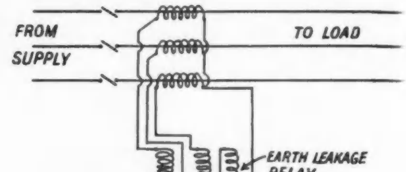


Fig. 5·3 - Combined Overload & Earth Leakage Protection.

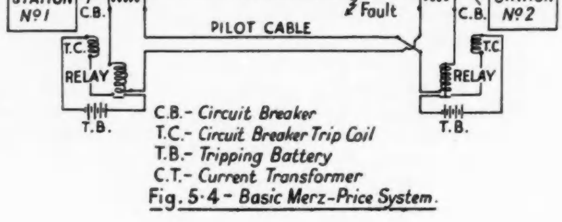
i.e. if no earth current is flowing in any phase. Earth current due to earth fault, however, destroys the current balance in the phases and produces a secondary current which can operate a relay or trip coil (Fig. 5.3). By utilising a relay operated tripping circuit the fault energy has only to close a relatively small relay requiring a few voltamperes, the actual tripping of the circuit breaker being brought about through the agency of a direct current provided by a storage battery usually trickle charged from a rectifier. This system gives maximum sensitivity, accuracy, and reliability, and the drop in line voltage associated with heavy fault current does not affect the tripping of the circuit breaker. The second method which due to the fact that the tripping battery, relay, etc., are not required, is cheaper but as the actual tripping energy is provided by the current transformers, and hence the fault current, this type of protection is less sensitive and has a lower accuracy than the former, because the whole of the energy required for the purpose of operating the circuit breaker tripping mechanism must be provided by the current transformer volt amperes i.e. fault current. One largely used method of obtaining combined overload protection (on two phases) and earth leakage protection is shown on Fig. 5.3 from which it will be seen that overloads on either two phases only will cause current flow through the secondaries (a) or (b) and so operate the relay contacts (d) through the trip coil (c). Under normal conditions there is, however, no current in the secondaries a and b.

For the protection of the H.V. system some form of discriminating system is essential if the fullest insurance against shut down is required, as it is very necessary to ensure that a fault on a particular substation H.V. equipment or cables shall only cause disconnection of that substation and shall not shut down other healthy substations. Further, it is extremely desirable that an H.V. cable fault outside the substation shall not shut down the substation transforming plant. Dealing with the question of discrimination between substations the case of the parallel feeder system may be considered first, it being assumed that the H.V. system with one source of supply only. Under these circumstances overcurrent and earth fault protection may be afforded by the use of non-directional relays at the source of supply and directional relays at the receiving substation as Fig. 5.1. A fault occurring on feeder 2 is fed directly by feeder No. 2 and indirectly by feeder Nos. 1 and 3. Thus the supply point circuit breaker and the substation circuit breaker will open leaving feeders No. 1 and No. 3 in service as at the substation the current flow direction is opposite to that required to operate the substation circuit breakers. At the main supply switching station the circuit breakers being non directional will commence to operate but due to the fact that the fault current is divided between Nos. 1 and 3 feeders and also due to the inverse time limit characteristics of the circuit breaker relays No. 2 feeder circuit breaker at the supply point will operate before the feeder circuit breakers Nos. 1 and 3 and thus the faulty feeder No. 2 is isolated without causing interruption to the electric supply.

A similar form of protection can be applied to ring main systems provided that the number of substations involved is not too great otherwise in order to obtain the necessary discrimination the total time lag may substantially reduce the short circuit current rating of the cable system or exceed the time lag period allowed by the Supply Authority as for example with a total time lag of .5 second the permissible cable current density is 150.000 amperes per square inch whereas if the time lag is increased to 2 seconds the current density is reduced to 75,000 amperes per square inch (see Section III Cable System H.V. and L.V.).

A typical case is that of a dock system having four substations in the ring main with one supply point. The protective arrangements may comprise time lag overcurrent relays at the main incoming supply switching point and directional or time lag reverse power relays at the incoming and outgoing circuit breakers at each substation, the directional or reverse power relays being set with a shorter time lag and arranged to trip when power flows **away** from the substation.

Typical time lag settings, are main supply point 2 seconds, No. 1 substation instantaneous and 1.5 seconds, No. 2 substation .5 second and 1.0 second, No. 3 substation 1 second and .5 second, No. 4 substation 1.5 second and instantaneous. The above arrangement ensures that in the case of a cable fault between any two substations two circuit breakers only will operate isolating the faulty interconnector between the two substations. In view, however, of the limitations of the period of time lag often imposed by Supply Authorities together with the reduction in the current carrying capacity of the cable under fault conditions, the more usual form of protection adopted is one of the variations of the basic Merz-Price system (Fig. 5.4). The basic Merz-Price system of protection is based upon the principle that under healthy conditions the current entering one end of a cable is equal to that leaving the other end. Under fault conditions, however, this condition no longer is maintained and the difference between the incoming and outgoing currents, through the agency of current transformers whose secondaries are connected in opposition, is arranged to operate relays and so isolate the faulty section of cable. This basic form of protection has the following disadvantages. A relatively high



C.B.- *Circuit Breaker*
T.C.- *Circuit Breaker Trip Coil*
T.B.- *Tripping Battery*
C.T.- *Current Transformer*
Fig. 5·4 - Basic Merz-Price System.

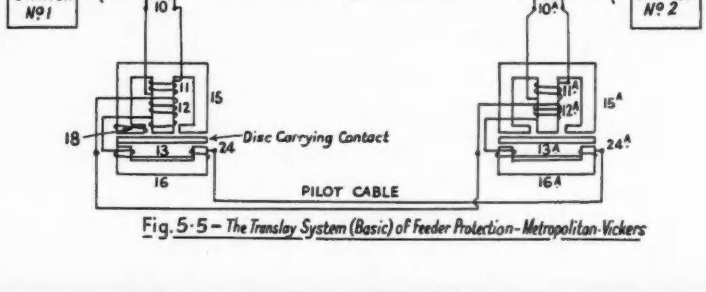


Fig. 5·5 - The Translay System (Basic) of Feeder Protection - Metropolitan-Vickers

Electrical Distribution as applied to Docks—continued

fault setting is necessary to ensure that operation does not occur except under fault conditions for the reason that accurate balancing of the current transformers is difficult and magnetic saturation is soon reached in transformers of ordinary design. Further, if exact balance, by the use of distributed air gaps in the current transformers in order to obtain straight line voltage characteristic with large primary currents, is obtained, heavy through currents in the primary may induce high voltages in the current transformer secondaries causing capacitance currents to flow in the pilot cables which will operate the relays unless the relay setting is high and generally the minimum fault setting that can be safely used in practice is in the order of 100% of normal load, which, of course, for earth leakage protection is on the high side. Much research has been carried out on the design of protection systems and it would be quite impossible to detail all the fault protection systems on the market at present in the space available, therefore, two representative types which are generally applicable to dock areas will be briefly dealt with.

The "Translay" (Metropolitan Vickers) system of protection which is named by virtue of the fact that it is a combination of transformer and relays is a development of the basic Merz-Price scheme designed to obviate the inherent disadvantages of the latter.

The operation of this system may be followed by reference to Fig. 5.5 which shows the "Translay" system in the simplest form, the tripping circuits being omitted to reduce complication. Under healthy feeder conditions the current transformers 10 and 10a carry equal currents and the coils 11 and 11a connected to them induce equal voltages in the windings 12 and 12a, coils 12 and 12a are connected in opposition by means of the pilot cables, the operating windings 13 and 13a being in series and in consequence no current circulates in the pilot cables and operating coils 13 and 13a. Current flows in both coils 11 and 11a in proportion to the load current flowing but due to the bias loops 18 and 18a a backward or restraining torque is produced effectively preventing operation of the relay. A fault on the feeder, however, causes the current transformer at one end of the protected feeder to carry more current, inducing a small current in 12 and 12a which circulates through the operating windings 13 and 13a and pilot cables. Thus both coils of the relay are energised the field coils 11 and 11a from the local current transformer in proportion to the magnitude of the fault current, and the operating coil windings 13 and 13a by the unbalance current circulating in the pilot cables, thus turning the disc of the induction type relay and closing the circuit breaker trip circuit.

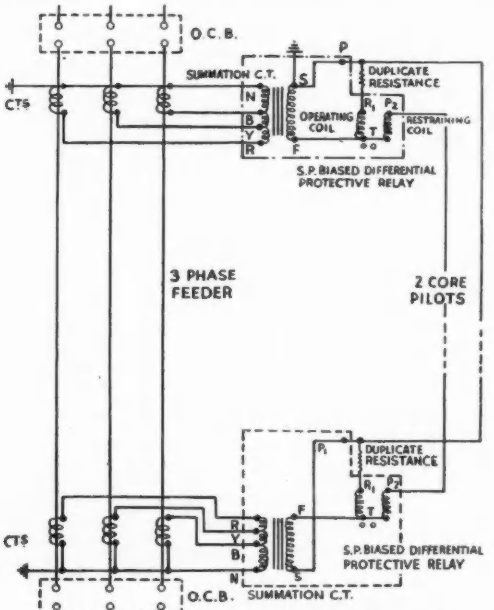


Fig 5·6 - *Twin Pilot Biased Differential Feeder Protection. General Electric Co. Ltd*

Typical fault settings of the above system are

Earth faults			Phase faults			Three phase faults
R	Y	B	RY	YB	BR	RYB
22%	28%	40%	90%	90%	45%	52%

Note: Percentages are in terms of current transformer rating and R Y B refers to red, yellow and blue phases.

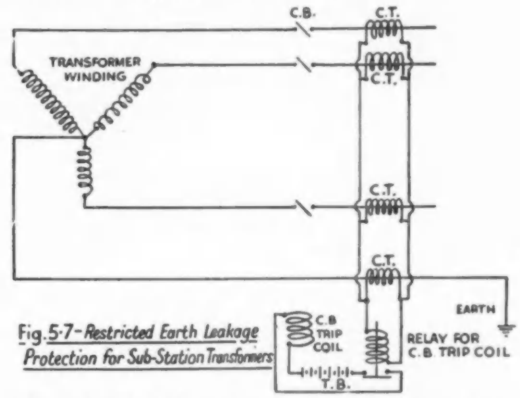


Fig. 5·7 - *Restricted Earth Leakage Protection for Sub-Station Transformers*

Twin Pilot Biased Differential Feeder Protection (General Electric Co. Ltd.).

This operates on the McColl principle but allows for a reduction of the voltampere burden in respect of the current transformer thus allowing the use of standard current transformers without undue loss in sensitivity and at the same time maintaining high stability. Single element relays together with one pair of pilot wires only are necessary. The system is shown on Fig. 5.6 and when operating under normal conditions or through faults, the outputs of the Sumation transformers are almost equal, and due to the matching of the operating and restraining coil circuit impedance the current divides equally and the relay has a definite bias in the restraining direction and is thus stable. An internal fault on the feeder causes the difference in current between the summation transformers to divide between the operating and restraining coils in the ratio of 3 is to 1 resulting in operation of the relay.

The relay is a single pole element of the induction type and due to the two separate magnetic systems restraining and operating, producing diametrically opposing torques, the relay is inherently stable during transient switching surges. Capacity currents in the pilot cables flow only through the restraining coils and thus slightly increase the restraining bias of the relay.

Typical fault settings applicable to the twin pilot biased differential system are

Earth faults			Phase faults			Three phase faults
R	Y	B	RY	YB	BR	RYB
33%	36%	54%	113%	123%	66.7%	96.6%

Where the percentages are in terms of current transformer rating.

Restricted Earth Leakage Protection.

In order to protect the substation transformer windings against earth fault the above system is often used. It is essential that the protective gear must not operate under the condition of a feeder fault and to meet this requirement an additional current transformer is connected between the main transformer star point and earth as shown in Fig. 5.7. In case of an earth fault on a feeder the fault current passes from the transformer winding, along the faulty cable, to feeder earth (fault) and returns to transformer star point through the star point earth. Therefore the fault current passes through two current transformer primaries in opposition and thus does not cause operation of the relay. Upon the incidence of a transformer winding fault, however, the fault current passes through one current transformer only i.e. that in the earth lead connected to the star point, the resultant current operating the relay and hence opening the circuit breaker.

(To be continued)

The Tetrapod Concrete Block

A New Technique in Breakwater Construction

When, in 1950, strangely shaped concrete blocks were used as a protective covering for the two jetty heads of the sea water intake for Casablanca's new power station, many coastal engineers were surprised and not a little sceptical of their success. The jetty heads are exposed to the sea in much the same manner as the main breakwater of the port of Casablanca, but whereas the latter is protected with rectangular blocks weighing 80 to 100 tons, the jetty heads are protected by these new blocks of only 15 tons in weight.

It is true that at the water-intake the depth is less than by the breakwater and that this limits the amplitude of the waves which may reach the structure. At the same time, however, this smaller depth causes certain waves to break right on the structure and this is extremely prejudicial to the stability of the block facing.

But all in all the general impression was that it was rather far-fetched to try and protect the breakwater from the very bad weather conditions which were expected, simply by using blocks, which though of special shape, were much lighter in weight.

However, after some years, during which the structure has been attacked by the most violent storms likely to occur in that part of the world, it may clearly be seen that the structure is of excellent stability and this new venture therefore was a complete success. It may be of interest to describe the fundamentals of this novel method and to indicate the applications to which it has been put.

The Origin of the Tetrapod.

Generally speaking the outer facing of a rubble-mound breakwater is made up either of natural stones or of concrete blocks, if natural stones of suitable size are not available. When concrete blocks are used, they are almost always cubic or rectangular in shape.

The weight of the blocks used and the gradient of the slope on which they are placed depend on the amplitude of the waves.

A great deal of research has been carried out on breakwater stability, in particular on what is required of a breakwater facing. No complete theoretical analysis of these phenomena has yet been made and indeed it would be very difficult to do so owing to the number of factors involved. However, some semi-empirical formulae have been proposed. These formulae have the great merit of providing a first approximation to the required solution and also of bringing out the various factors which enter into the problem. One of the best known formulae is that of Professor R. Iribarren Cavanilles:

$$W = \frac{Sr.\ KH^3}{f\,(\cos\alpha - \sin\alpha)^3\,(Sr-1)^3}$$

in which:

- W = is the weight of individual cap rock in kilograms,
- K = 15 and 19 for breakwaters constructed of natural rock-fill and artificial blocks, respectively,
- H = is the height of wave, crest to trough, which breaks on the structure, in metres,
- Sr = is the specific weight of cap rock in metric tons per cubic metre,
- α = is the angle, measured from the horizontal, of the seaward slope.
- f = the internal friction coefficient.

Besides the weight, the density and the slope, there are the coefficients K and f which are constants. Their value is determined experimentally for each kind of facing block.

It is a surprising fact that, until quite recently, consideration was given almost exclusively to the weight and to the slope. The nature and the shape were considered as factors falling outside the engineers' sphere of influence.

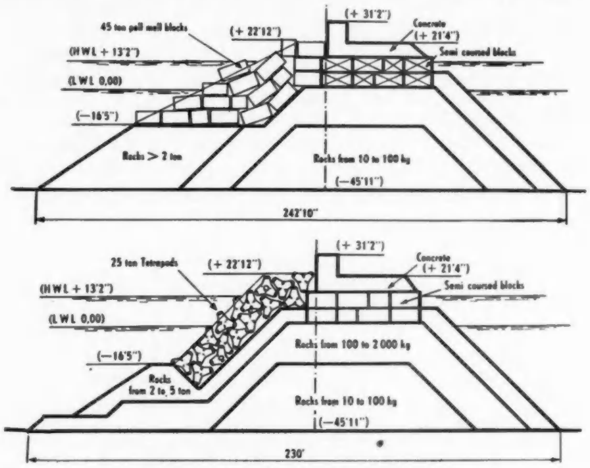
Some years ago, owing to comparatively new techniques, it was possible to obtain a better knowledge of the mechanism by which a facing resists wave action and it then became clear that consideration should be given to the nature and shape of the facing blocks.

Once the wave filter had been invented, it became possible to reproduce periodic wave phenomena in the laboratory, and to observe water movements on the surface and within breakwaters. The great strides thus made in the technique of the scale model showed how the values of the two coefficients, until then considered as constants governed by local conditions, could be altered and improved.

Importance of the Shape.

A film shown in 1949 to the International Congress of Navigation, demonstrated the mechanism of the forces which are exerted on the breakwater and more particularly on the blocks of the facing. One of the most characteristic phenomena which it was possible to see was the lifting of the blocks under the effect of the pressures which act from the inside to the outside of the revetment when the wave recedes. The water-filled facing then tends to collapse seawards. This observation was the starting point of a series of studies which were made to ascertain how essential it was to have a permeable facing. Instead of counter-balancing the pressure by the weight of the blocks, the pressure is eliminated by allowing the water to flow out from the facing.

Nevertheless the permeability must be high enough and must exist at every point of the facing without being liable to appreciable change, which might occur due to either an unfortunate positioning of the blocks or because of the movement of the facing under the action of the sea.



Sections of main breakwater at Safi.

Another feature of the facing to which the tests drew attention was the fact that roughness brings about a very great dissipation of wave energy over a very short distance. This leads to a decrease both in the wave reflection (always unfavourable for shipping) and in the overtopping which is often the cause of damage to the crest or to the rear slope.

Finally, after further investigations, it was suggested that the locking of the blocks together would consolidate the facing. By increasing the coefficient of friction it would be possible to obtain steeper slopes, thus enabling substantial saving to be achieved.

When natural stones are used it is difficult to change the shape of the block, but concrete blocks can easily be arranged to interlock. Tests have shown that the edges of the rectangular blocks play a very important part and that stability is greatly reduced when these edges are blunted. This confirmed the advisability of arranging for the blocks to interlock but, at the same time, showed that this interlocking, if it is to be effective and lasting, should not depend on the condition of parts so fragile as the edges. Interlocking must therefore be achieved by the actual shape of the blocks.

All these studies and tests indicated that the following qualities should be possessed by a breakwater facing:

(a) permeability,

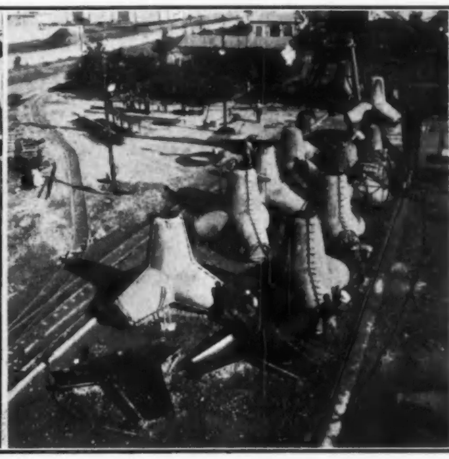
(b) hydraulic roughness,

(c) high and constant coefficient of friction.

When conventional concrete blocks were examined from this point of view serious defects at once became apparent and it was thought advisable to try to find a more suitable shape than the

The Tetrapod Concrete Block—continued

Placing a tetrapod at Bastia, Corsica.



View of the tetrapod construction yard at Safi, Morocco.

General view of a sea wall protected by tetrapods at Sousse, Tunisia.

rectangular one. Further studies were undertaken and resulted in the invention and subsequent development of the tetrapod block.

The Tetrapod.

With this type of block, facings can be built which have in high degree the qualities described above and these may be summarised as follows:—

(a) A facing formed of tetrapods interlocked one with another provides very high roughness and permeability. The voids ratio is slightly greater than 50% and remains practically the same however the tetrapods are placed. The dissipation of wave energy is effected by division of the mass of water into smaller turbulent streams which collide with each other in the interstices of the facing.

Extreme end of the jetty head of the Power Station at Casablanca—Roches Noires, Morocco.

(b) The legs facilitate the interlocking and the slope can be steepened to nearly 1 in 1.

(c) The truncated-cone shape of the legs particularly favours progressive keying of the structure. The block can be tipped over and rolled only with great difficulty. The keying does not depend on the state of edges: it is the shape itself which plays the main part.

These various qualities of the tetrapod are of great consequence in the design of coastal structures since it is possible to reduce the individual weight of the block, the total volume of facing concrete, the wave reflection, the overtopping, and also the slope.

Numerous examples show that the saving made on the total price of the structure by the use of tetrapods is from 20 to 30% as compared with a conventional design of the same efficiency and the same strength. This reduction in cost encouraged engineers to test out the system on a full scale.

In the meantime methods of tetrapod manufacture had been studied and it was shown that with well designed methods the manufacture of tetrapods presented no more difficulties than are met with in the moulding of ordinary blocks.

From an economic point of view, it can be considered that the use of tetrapods would be advantageous where concrete blocks are required. However, when good quarries are available and the wave characteristics allow a facing of large sized natural stones to be considered, tetrapods are not necessarily to be recommended. Each case has to be considered separately, and for smaller structures, where the protective layer may be made up from readily available natural stones, the use of tetrapods would be unnecessary. When recourse has to be made to concrete, however, tetrapods usually provide the best solution.

Utilisation of Tetrapods.

After the first results the number of tetrapod structures increased rapidly and now many structural engineers consider this method almost as a classical technique. They were first used at Casablanca; 4 ton tetrapods were subsequently employed at Sousse (Tunisia) to complete the upper part of a breakwater the construction of which had been begun with 7.5 ton cubic blocks and which had already suffered considerable damage.

Later, a large work programme was undertaken in Morocco. It consisted in extending the main breakwater at Safi where the water was never less than 46-ft. deep. The part of the breakwater which had already been built was 4,000-ft. in length and was covered with 45 ton rectangular blocks laid on a slope of 1 in 2, which enabled it to resist the action of 25-ft. waves. After very detailed studies the breakwater extension was built and faced with 25 ton tetrapods. The slope is 1 in 1. A comparison of the two sections indicates the saving achieved.

The Safi tetrapods are lightly reinforced with steel, but manufacturing and positioning experience combined with systematic strength tests have unequivocally demonstrated that the reinforcement is quite unnecessary. In spite of legs which seem long, the block is sturdy and of very high strength. A glance at the dismantled form-work shows where lies the strength of the tetrapods: each quarter-form can be seen to have little curvature.

Further examples of the use of tetrapods in new structures are: Funchal (Madeira Island), La Rota (Spain), Crescent City (U.S.A.), Rongotai (New Zealand), Amasra (Turkey), Kanazawa (Japan), and for strengthening existing structures: Bastia (Corsica), Wick (Scotland), Kahului (Hawaii). In all 350,000 tons of tetrapods have been used to face breakwaters throughout the world.

Pre-cooling Store for Table Bay Harbour, South Africa

Extension of Present Facilities

Because of the continued rise in fruit exports, deciduous as well as citrus, from Table Bay during the past few years, pre-cooling facilities at this port are being extended. Work was started on the building of a new pre-cooling store at an estimated cost of £2,000,000. The new store, which is being built at D berth, will for the present, be equipped to handle only 4,700 tons, but can at a later stage be equipped to handle 10,000 tons. During the off-season, portion of the store will be used as a cargo shed.

The ground floor of the new building will be used as a reception airlock and will have a rail track running through the centre. Incoming fruit will be offloaded and sorted on this floor, whereafter it will be conveyed by goods lifts to the first floor on which 56 pre-cooling chambers will be located. Each of these pre-cooling chambers is designed to accommodate two rows of nine fully loaded four ton skids parked side by side, allowing a minimum of air space between the skid-loads and the chamber walls. This arrangement ensures that cooling air is passed directly through the boxes of fruit.

The roof of the first floor will consist of a reinforced concrete slab approximately 200-ft. wide and 780-ft. long, and will be surmounted by a pitched impervious corrugated iron roof extending from one end of the former to within 75-ft. of the other end. The remaining 75-ft. by 200-ft. area will be surmounted by the office accommodation which will be served by a stairway and one passenger lift.

The purpose of the "double" roof to the pre-cooling chambers is to reduce the temperature variation of the concrete slab to a minimum. In addition light slagwool insulation, completely inert and weighing ½ lb. to a square foot layer 1-in. thick, will be located directly underneath the concrete roof.

An interesting feature in the design of this building is that owing to the shortage of ground space the first floor will be cantilevered a distance of 5-ft. beyond the columns adjacent to the railway tracks and the main columns of the building will support approximately 200 tons each. Investigations are being carried out to ascertain whether the use of a pile foundation will be required.

The main pipe duct, which will carry the nest of pipes varying up to 10-in. in diameter, will be located down the centre of the store and mounted immediately underneath the concrete roof. Each cooling chamber will be 11-ft. 6-in. wide and 77-ft. long with a nest of coils housing the 2,500-ft. of piping containing the brine cooling liquid and will be equipped with a 4-ft. 6-in. fan capable of drawing 27,000 cu. ft. of air per minute.

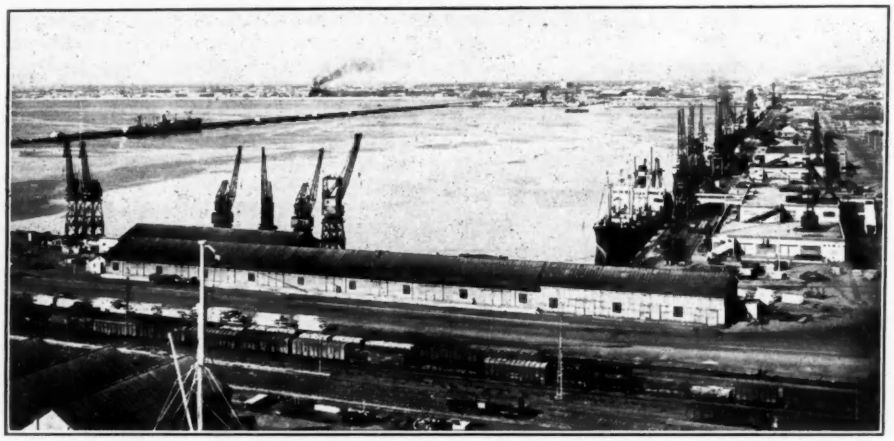
The equipment for the handling of the fruit in the store will consist of battery trucks and skids as at present in use in the existing pre-cooling stores at Table Bay. Several additional harbour cranes will be provided and a gantry erected connecting D berth with C berth to facilitate the loading of vessels tied up anywhere along D, C, B or A berths.

During peak periods the centre railway track in the new store will also be used to facilitate offloading of fruit into the airlock and an additional shelter, to house approximately 190 fruit trucks, will be provided.

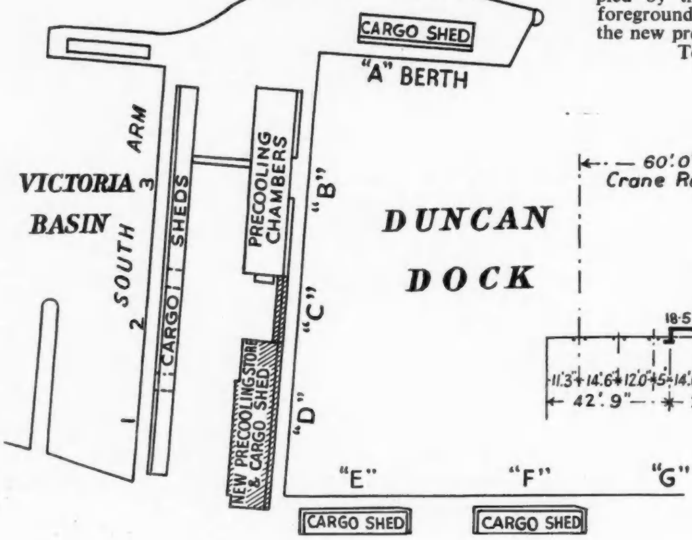
Additional Facilities and Sub-Stations.

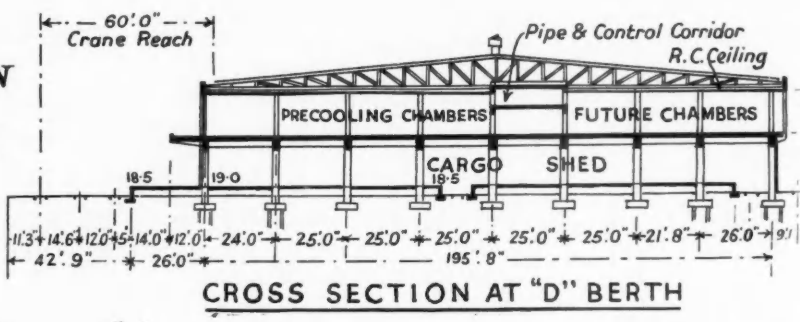
In addition to the new building at D berth the existing facilities at the South Arm are being enlarged at an estimated cost of £137,000 increasing the capacity by an additional 3,000 tons of cold storage space. This will bring the capacity of the pre-cooling stores at Table Bay to a total of 11,300 tons with accommodation for 16,000 tons on completion of the new building at D berth and an eventual maximum capacity of over 21,000 tons.

Two additional power sub-stations will be provided for the extra pre-cooling facilities. The one for the new store at D berth will be equipped with three 750 kVA 11.8 KV to 400 volt transformers and switchgear and its main load will be the 56 circulating fans in the pre-cooling chambers. The other feeding the engine room will consist of two



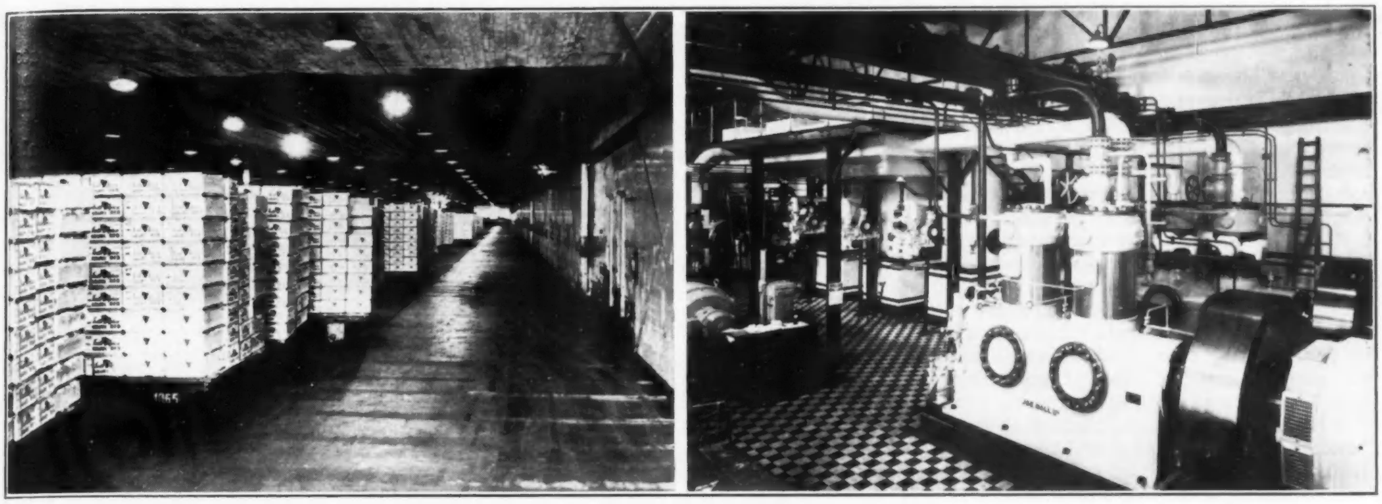
(Above): The site, at present occupied by the cargo sheds in the foreground, which will be used for the new pre-cooling stores at Cape Town Harbour.





The diagrams show (left), the position to be occupied by the new cooling store at Cape Town and (right), a sectional drawing of the new cooling store.

Pre-cooling Store for Table Bay Harbour – continued



The illustration shows (left), skids of grapes waiting to be placed in the pre-cooling store and (right), the cooling plant at Cape Town.

chambers accommodating initially four 750 kVA 11.8 KV to 400 volt transformers and associated switchgear. The anticipated maximum demand for the two sub-stations will be 3,500 kVA which will eventually approach 4,600 kVA

The existing engine room at B berth will be enlarged and the equipment will be more or less doubled to cater for the requirements of the new pre-cooling stores by the provision of an additional four 250 H.P. compressors, four 40 H.P. salt water pumps, four 40 H.P. brine pumps and two 50 H.P. complete refrigeration sets. When equipping the new pre-cooling store to its maximum capacity at a later stage an additional two 250 H.P. compressors, two 40 H.P. salt water pumps and two 40 H.P. brine pumps will be installed.

The electrical equipment at the new store at D berth will include 56 four H.P. two speed reversible fans and five 40 and five 15 H.P. lifts with an additional 40 fourteen H.P. fans to be installed at a later stage.

This equipment will be specially designed for protection against the cold and humid atmosphere and corrosive fumes.

The increased power loading will necessitate a new supply line from the Salt River power station to the existing main harbour distributing sub-station. Duplicate cables from the main sub-station will feed the two pre-cooling sub-stations.

The existing pre-cooling accommodation, which was enlarged from 4,710 tons to 7,080 tons in 1951 at a cost of £171,000, consists of a store of 4,330 tons capacity at B berth, Duncan Dock, from which pre-cooled commodities can be conveyed direct to vessels at this berth, or via an underground tunnel to the adjoining A berth. Fruit may also be shipped at Nos. 3and 4 berths, Victoria Basin, via an overhead gantry. In addition, accommodation for the cold storage of 2,690 tons of perishable cargo is available at A berth while at the South Arm there are facilities for the pre-cooling of a further 1,280 tons. Between them these stores handled 293,505 of the 1956 total of 524,821 tons of fruit exported from South Africa, more than all the other harbours put together.

Stevedoring Productivity at the Port of Haifa

Summary of Output during 1956

The Research Section of the Port of Haifa Authority recently published their second bulletin in English summarising productivity results at the Port during 1956. Readers of the "Dock and Harbour Authority" will recall that the first bulletin, giving details of the results for the year 1953, was extensively reviewed in the May, 1954, issue of the Journal.

The present bulletin contains a number of charts and tables and emphasises once again that stevedoring performance is rather difficult to analyse statistically due to the complexity of the factors involved. It gives a short account of the method of analysis used.

It states that the "yardstick for measuring productivity is the tons per gang-hour, not the tons per man-hour rate of output.

"This may be justified for two reasons. Firstly, from the Port Authority's point of view, what counts is the quick despatch of the ship rather than the cost this involves for the contractor who performs the job; gang-hour productivity thus seems more important than man-hour productivity and the Port Authority would see to it that the gang-strength is such as to assure the quickest possible despatch compatible with reasonable cost.

Secondly, the composition of the stevedoring gangs is, in the main, constant for the various types of cargo. The typical gang consists of six men in the hold, two winchmen, one signalman, and one foreman, or ten men in all."

After more details of the analysis methods employed, the report raises the query "But to what extent may mechanisation proceed and the operation yet continue to be called stevedoring. This question arose at this port in September, 1955, when a grain silo, equipped with pneumatic elevators, was first put into service.

"As there are good arguments both for and against including the output of the silo in our productivity index, we decided to split the index in two branches as from that month. One branch of the index, called the 'overall productivity index,' includes the silo, while the other, which excludes it, is called the 'labour productivity index.'

"In calculating the output rate of the silo, we equated two suction pipes of the pneumatic elevator, and the team that operates them in one hold, to one ordinary stevedoring gang. Since the elevator is fitted with four pipes, the output per ship is twice the output per gang, provided all the pipes are employed.

"The productivity statistics relate to cargo handled at the main port only, but not to that handled at the Kishon auxiliary harbour, and also include only cargo discharged from or loaded to dry cargo vessels, not passenger ships or tankers.

"Furthermore, the statistics do not cover all dry cargo vessels in the main port but only a large and representative sample of them."

For the benefit of readers unacquainted with local conditions the bulletin adds a short account of the operating conditions at the port.

"Haifa is Israel's only deepwater harbour and handles some 80 per cent. of the country's sea-borne trade. Imports and exports of general and bulk dry cargo through the port last year totalled 1,807,000 tons. Imports predominated with 63 per cent. of the total traffic.

"The port is owned by the State and administered by the Port

Stevedoring Productivity at Port of Haifa—continued

of Haifa Authority, a division of the Ministry of Transport. The physical handling of cargo—stevedorage, porterage, and lighterage—is in the hands of private contractors who operate, however, under the direct control of the Port Authority. The stevedoring statistics are one of the means of control.

"Cargo is handled mostly at marginal type wharves, and, to a lesser extent, to cargo jetties. Wharves and jetties are in the harbour basin, well protected from wind and swell by a main and a lee breakwater. Only 10 per cent. of all cargo is lightered from ships moored to the main breakwater.

"The port is served by rail and by road. Haulage to the port is 55 per cent. by rail, 45 per cent. by road. Haulage from the port is 35 per cent. by rail, 65 per cent. by road. Fifty-five per cent. of all cargo are transferred direct between ship and road or rail carrier, while only 45 per cent. passes through the port's transit sheds or open storage dumps. General cargo is still being handled in the great majority of cases by ship's gear. This will soon change with the expected arrival of modern level luffing portal cranes.

"Almost all grain and seeds pass through the grain silo which handled in 1956 a total of 423,000 tons. Potash, too, has recently begun to be handled over a special bulk loading plant.

"The majority of port labour is permanently employed and enjoys guaranteed minimum monthly wages under a far-reaching decasualisation plan. Most port work is on incentive pay, the dockers receiving premiums in direct proportion to excess of daily output over norms."

The main findings of the bulletin are as follows:

"The labour productivity index advanced from a yearly average of 106 points in 1955 to 112 points in 1956, an increase by six points.

"The grain silo, which began operating in September, 1955, added to the labour productivity index 3 points in 1955 and 20 points in 1956, bringing the overall productivity index from 109 points in 1955 to 132 points in 1956.

"Contemplating the indices over the four years, 1953-56, the amplitude of the monthly fluctuations is striking, understandable though they are in view of the great number of factors which influence stevedoring output.

"Yet behind the fluctuations a certain pattern can be discerned in the movement of the indices.

Seasonal Fluctuations: The labour productivity index shows a strong upward movement in spring and the early summer, with a tendency to a double peak, one in March or April, due no doubt in part to the impact of the citrus season, when top premiums prompt the workers to special effort, and the other around June. Then, in July or August, comes a sudden trough that cancels out almost all the previous gains and lasts for approximately two months. It is followed by a renewed upward surge in the autumn which reaches its peak by October or November, is then slowed down or even inverted owing to the winter rains, and thereafter rises towards new spring and early summer heights.

"Since the monthly contribution of the silo is more or less constant, the pattern of the overall index follows closely that of the labour productivity index.

"Without being certain of the causes of the summer trough, it may be reasonably assumed that it is due partly to the depressing summer heat and partly to the annual leave mostly granted during those months to the skilled permanent workers who are then temporarily replaced by less experienced casual labour."

The impact of changes in the output rates of main commodities on the productivity are recorded. The report states that the effect on the productivity index of an increase or a decrease in the output rate of a certain commodity in a given month depends, on the one hand, on the amplitude of the change, and on the other hand, on the quantity of the commodity handled during the month.

Comparison of Output Rates of the Main Classes of Cargo in 1956 and 1955.

Grain and oil seeds in bulk, handled this year almost exclusively by the pneumatic elevator of the silo, registered the largest improvements with 71 per cent. and 135 per cent. respectively. Scrap iron followed next with an increase of 60 per cent.

Other sizeable commodities whose output rates increased in 1956 over those of 1955 were:

(a) In Discharging: Metal pipes (+32 per cent.), metal sheets (+22 per cent.), sawn lumber (+18 per cent.), frozen meat (+17 per cent.), logs (+16 per cent.), boxboard (+14 per cent.), and metal bars (+10 per cent.).

(b) In Loading: Cargoes n.e.s. (+18 per cent.), bagged chemicals (+8 per cent.), and cement in paper bags (+5 per cent.).

"The commodity whose output rate dropped most heavily (−38 per cent.) is grain bagged in ship's hold, but the volume of this class of cargo has become insignificant, since the grain silo began working.

The other main commodities where a drop in output rates was recorded in 1956 were:

(a) In Discharging: Bagged flour and sugar (−17 per cent.), minerals in bulk (−17 per cent.), wooden poles and sleepers (−14 per cent.), heavy lifts (−13 per cent.), copra (−10 per cent.), frozen cargo n.e.s. (−6 per cent.), and coal (−6 per cent.).

(b) In Loading: Minerals in bulk (−16 per cent.).

Productivity by Type of Gear.

The operative tables, included in the report, would appear to point to the advantage of shore cranes over ship's gear. The superiority is particularly salient with regard to bulk cargoes such as minerals and coal, where the rhythm of work is determined by the capacity and speed of the gear used rather than by the physical effort of the stevedores. For other cargoes, the advantage of the shore cranes would seem to be partly lost because of the necessity to wait until the slingloads are prepared.

Non-Productive Working Time.

The overall average of non-productive working time decreased slightly from 22.6 per cent. in 1955 to 22.4 per cent. in 1956.

Analysed by operations, there was an important improvement for discharging to the silo, where lost time came down from 23.3 per cent. in 1955 to 14.2 per cent. in 1956, and a slight improvement in respect of citrus loading. For the other operations, non-productive working time increased slightly.

The comparison by months reveals, apart from the usual seasonal increases which are due to the rain, a relative decrease in non-productive time in the last two months of 1956.

Turn-round of Vessels.

The average time spent in both the main and the auxiliary ports by all dry cargo vessels arriving under load in 1956, from arrival to end of discharge, was 4.8 days. Of these, 1 day was waiting time prior to discharge*, 3.2 days actual working time, and 0.6 days were Saturdays and other holidays when work was suspended on vessels which had started discharging before.

This overall average represents only a very slight improvement over the previous year, when the average was 4.9 days, but compares favourably with the averages of 5.4 in 1952 and 7.1 in 1950.

Dividing the quantity of cargo discharged by the number of days the vessels stayed in port, the report finds that the average discharged per vessel and day increased from 188 tons in 1950 to 250 tons in 1952, 333 tons in 1955 and 361 tons in 1956, an increase of 92 per cent. over 1950.

* This figure refers to dry cargo vessels, excluding passenger vessels which unloaded cargo. The figures for passenger vessels are, however, included in another section of the report.

New Passenger Terminal at Tilbury.

The new passenger reception hall at No. 1 berth, Tilbury Dock, Port of London, is expected to be ready shortly. The hall will have a comfortably furnished lounge, buffet and licensed bar, writing desks, information counter, florists shop and travel agents facilities. Passengers will have easy access to the adjoining railway platform or into the large covered car park. The enclosed galleries overlooking the waterfront will have accommodation for more than 100 people.

Construction of the new quay, at a cost of £1,500,000, has been in hand for the last four years. The work includes cargo sheds and road and rail facilities.

Timber Handling at British Ports

The Use of New Equipment and Methods

By Col. R. B. ORAM, O.B.E.

In recent articles in these pages it has been suggested that difficulties experienced by dock undertakings in dealing with the seasonal rush of softwood timber are largely the result of lack of co-ordination between those who handle timber cargoes and the makers of mechanical equipment. One writer doubts if the manufacturers ever approached the market with the idea of finding out what is needed. There was, in his view, too much of the "take it or leave it" attitude to mechanical equipment as used in the timber handling docks in this country.

Before examining the steps that have been taken to secure machines constructed especially for timber handling, as the result of the interchange of ideas between user and maker, the problems that confront port authorities must first be appreciated, for they vary with the physical layout and the customs of each port. For example, in London, where a large area of the Surrey Commercial Dock is given over to timber, the problem has never been a simple one. From July to February ships from the Baltic arrive with full cargoes of softwood, the traffic building up to a peak during the worst weather conditions of the year. Probably over 80 per cent. of this timber will be delivered overside, the remainder being roughly piled on the quay alongside the ship. As the disposition of the cargo is frequently altered by last minute transfers, the Port of London Authority rarely know in advance how many parcels for sorting and piling they will be required to take. Prior to each season there is no defined tonnage which is known to require housing during the coming months; so much will depend on market conditions.

Against the background of this fluctuating demand for valuable piling space, keeping the quays clear for incoming ships is the problem calling for the closest examination. Quay congestion can be relieved by taking overside (and the Authority have now added considerably to their pre-war fleet of barges) parcels for housing, in parts of the docks where ships cannot penetrate.

Until softwood is imported in unit loads already sorted to size, there is no alternative to sorting these huge quay bulks manually and piece by piece. Time and custom have made the dealporters uncannily expert and sorting is done by the eye. The fact remains that there is no device suitable for sorting the vast tonnage of timber that passes annually over the dock quays.

Before the Second War the work of dealportering was arduous but the pay was good; the seasonal nature of the work appealed to men who craved variety of occupation. Since the war the number of dealporters has dwindled. A gang of 30 dealporters, once a common sight, is now out of the question. Post-war dealporters have no desire to emulate the feats of their fathers and they willingly acceded to using mobile cranes as integral parts of the smaller gangs. The practice of backing deals is now almost extinct.

Even the simplest form of mobile crane was difficult to procure during the immediate post-war years. There were also long delays before delivery. It was not surprising that many of the early types of mobile cranes did not stand up to the strenuous dock conditions. The new equipment had not been built with the primary intention of being used in the docks. There was no escaping this fact, although it came as less of a surprise to those whose introduction to the new machines had been made under war conditions at overseas ports.

In London a careful survey was made of the drawbacks that a few years' use had revealed in the mobile crane. The problem was attacked both from the maintenance and spares angle as well as the operational. Discussions with a leading firm of crane makers followed and the very valuable findings, to which daily conditions of dock use had pointed, were quickly appreciated. Later, when the question arose of buying more mobile cranes for use on timber, specific requirements were posed to crane makers. Apart from better luffing, slewing and travelling duties a demand was made that the new cranes should be able to lift a set of wood weighing one ton, from the rear stowages in the shed. It was the intention that the crane hook should operate 18-ft. from the platform; it could also expect to find a front pile of timber, perhaps 23-ft. high, which would obstruct the desired load; all this under a shed roof of 30-ft. The crane makers were, in fact, asked to produce a crane that would confer the great advantage of an overhead gantry, able to plumb any part of the shed stowage. If a crane could be built to do this, the high cost of a traveller in each shed would be avoided. When the crane was not employed on timber it could be used elsewhere in the dock, thus avoiding the frozen capital inseparable from fixed machinery.

The ingenuity of the crane makers was stimulated by this challenge. After discussion and experiment a fast moving and operating mobile crane, with a lifting capacity of 4 tons (necessary to lift 1 ton at 18-ft.) was produced. The distinguishing feature was a swan-necked cantilever jib mounted in a high position. The most forward section of 6-ft. of this jib can be removed by a fitter within a few minutes; the crane is then most useful for normal timber work and also for general dock work. Incorporated in the new crane are four-wheel air brakes, protection against overloading and over-hoisting, and finger tip control of the main motions. As further proof of co-operation the makers offered free instruction to the users' crane drivers.

A diesel electric crane with cantilever jib capable of lifting 4 tons, shown lifting load from the rear of the shed stowage, over the piles in front.

A description of this crane is worthwhile if it refutes the "take it or leave it" idea. In this instance the discussions were frank and fruitful. In tackling other aspects of the timber problem co-operation has been equally fruitful, although talks have been mainly internal, as between user and engineer. German bombing, plus old-age, accounted for 233 out of 324 timber sheds in pre-war use at the Surrey Commercial Docks. With few exceptions the sheds destroyed were all out of date.

As soon as the acute post-war shortage of steel permitted an improved type of timber shed was evolved. Not only did consultation with the engineer produce a shed that would meet both present and future needs of mechanisation, but time was saved by standardising the dimensions. Briefly, the post-war shed is 30-ft. high and 65-ft. wide; a convenient length is 300-ft., but this can be altered by the model arrangements of bays. The width

Timber Handling at British Ports—continued

allows for a gangway of 15-ft. surfaced to save wear and tear on tyres, with piling areas 25-ft. wide on each side. This lay-out has been found suitable for even the longest lengths of British Columbian pine whilst Baltic timber can be doubled-up in the most economical way.

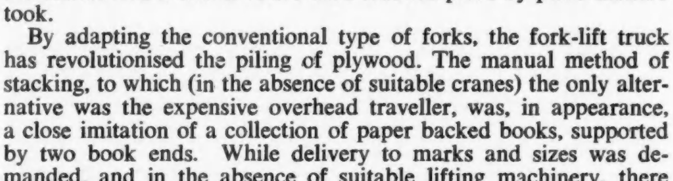
Before leaving conditions in London, mention must be made of the annihilation of that old time-and-money wasting bogey, extra distance. Even in his prime the dealporter jibbed at carrying more than 300-ft., neither is it the function of a mobile crane to carry loads for long distances. The solution was found in a heavily built tractor and a fleet of trailers, the latter particularly suited to carrying timber on the flat. Parcels landed where there is no adjacent shed room can now be quickly and cheaply transferred to a storage perhaps a quarter of a mile away.

Hardwood and Plywood in the Port of London.

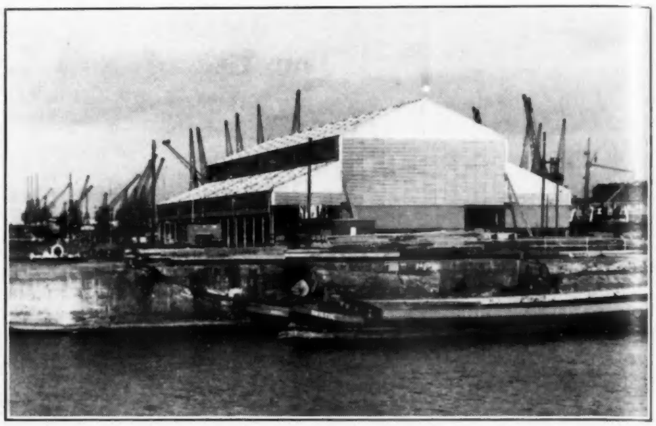
The inference in the articles in previous issues was directed in the main to the handling of softwood. This important commodity has two relatives—and they are by no means poor relations—hardwood and plywood. In the past, both of these have presented complicated problems to the dock undertakings responsible for housing the large tonnages that flow into the ports of this country. Plywood, with its heavy and inert packages was never a popular item; the many sizes that are a feature of this trade and the retail deliveries insisted upon by the buyer, made it impossible to handle economically by manual means.

A new method of piling hardwood in standard sized sets, each containing about 600 super feet (or 1 ton/load) and 3-ft. wide, so that two will sit comfortably on a lorry, has been evolved. The old conception of a single horse load, which for so long dominated the piling system, has disappeared with the reason for its use. Mobile cranes now build piles of more than 20-ft. high; they also deliver the timber in a fraction of the time that the piece by piece method took.

By adapting the conventional type of forks, the fork-lift truck has revolutionised the piling of plywood. The manual method of stacking, to which (in the absence of suitable cranes) the only alternative was the expensive overhead traveller, was, in appearance, a close imitation of a collection of paper backed books, supported by two book ends. While delivery to marks and sizes was demanded, and in the absence of suitable lifting machinery, there was little more that could be done. Overhead travellers were too expensive for a dock undertaking whose economical use of shed space—and the fact must never be lost sight of—is always restricted by the need to keep each Bill of Lading separate until almost the final delivery. All that is now altered. In place of the tedious hand trucking and stacking followed by largely ineffective re-stowing to make room for new parcels, the fork-lift truck quickly carries several bales at a time to the final pile. A code of bedding numbers allows the sorting to be done by the truck; wholesale repiling can be faced by making use of the bedding code and the truck, during those times when it is not required for deliveries. The poor turn-over and the loss of space that were always associated with plywood storage are now both nightmares of the past, thanks to the co-operation of the operator and the maker of the equipment.



Piling plywood with the aid of the fork-lift truck.



Timber shed at Royal Edward Dock, Bristol.

Methods Employed at Bristol.

The port of Bristol Authority has since 1945 spent nearly £250,000 in improving the timber handling facilities in their docks at Avonmouth and Portishead. Unlike the conditions in London overside deliveries account for only 28 per cent. of the total ships' cargoes. The Authority expects to pile an additional 13 per cent. and this is handled across the quay. The remaining 59 per cent. also crosses the quays either being delivered direct to rail wagons or to road vehicles. Due to the excellent delivery facilities provided by the Authority not only are the main importers, whose yards are in the Bristol area, sure of getting quick delivery, but the parcels for piling are immediately removed by straddle carriers to the piling area. Quays are normally kept clear of timber so as to ensure that berths are available to incoming vessels.

Post-war improvements at Avonmouth have, therefore, been directed to keeping the quays clear and ensuring the constant through movement of rail wagons and road vehicles. Since 1949 an area behind the quay berths has been equipped for timber storage and a shed with undercover accommodation for 1,000 standards (an extension is now under contemplation) has been built. To add to the efficiency of this new piling area and to improve the discharging conditions, crane tracks for 3 ton electric cranes have been extended. Road and rail access has been provided to the new shed and stacking ground, and extra rail sidings and capstans installed. Less spectacular, but equally expensive, has been the laying of a hardcore surface on which the modern straddle carrier can work without damage.

African hardwood logs, both round and square, form part of Bristol's timber imports. To handle these cargoes, notorious for the arbitrary weights constantly encountered, tracked mobile cranes of 10 tons capacity have been bought. Straddle carriers and railwagons are used to keep the quays clear of logs.

The Problems at Hull.

Timber problems at Hull have been complicated by the need to co-ordinate improvement schemes with claims from many other trades. The work of ship discharge and subsequent handling is done by the shipowners, their agents and timber contractors. The assistance that can be given by the British Transport Commission is limited to speeding up the turn-round of the ships and their cargoes. The King George Dock where the larger ships are berthed is being entirely re-equipped with 45 new electric cranes. To the outlay for these of £750,000 was added an extra £200,000 for conversion of the electricity supply from D.C. to A.C.

Timber Handling at British Ports—continued

Straddle Carriers transporting timber from the quay to the open storage grounds, at the North of 9 Dock, Manchester.

Enemy damage in the port of Hull has involved very heavy repair work and new construction. The programme has included a new concrete quay at No. 12 berth to replace the old wooden quay. Elsewhere new surfaces have replaced the old stone setts, roadways have been widened and new rail sidings installed for the transhipment of softwood and hardwood. Much of the timber in the Hull docks is taken direct from the ship's side by rail bogies to merchants' tenancies. Each bogie can carry a load of 7 tons and they are hauled by a fleet of diesel tractors recently purchased by the Commission. The latter body have been quick to call upon their own resources to help the turn-round of timber at Hull. During 1956, 1,500 ex-main line goods wagons were adapted for timber carrying at a cost of £43,000, making a total transfer to Hull of over 4,200 of these useful carriers. Two 6 ton mobile cranes are now in use on ship discharge, and a scheme for rebuilding 900-ft. of quay for extra ship berths is under review.

Unique Conditions at Manchester.

Timber is imported into Manchester under conditions unique in the timber ports. The whole of the ship's cargo comes ashore and is handled throughout by labour employed by the Manchester Ship Canal Company. Once ashore, if it is not delivered direct to road or rail, the timber is taken either to dispersal areas which may be half a mile distant, or conveyed direct from the ship to merchants' premises adjoining the dock estate. In addition, under-cover storage is provided for 12,000 standards, sorted and piled to Bill of Lading sizes.

It would not be possible to handle this succession of full ships' cargoes ashore unless careful thought had been given to the problem met with in every timber port, of keeping the quays clear. Since 1946 an area of 200,000 square feet has been asphalted and a land area, parallel to the quay, has been surfaced, making possible the quick transit of timber by straddle carriers, tractors and trailers. The berth usage is now three times that of the pre-war standard. New electric quay cranes and mobile diesels speed the discharge and take care of the carrier loads as they arrive at the dispersal and piling areas.

Enough has been said to set forth the difficulties that face port authorities who handle timber in bulk. The success which they and the equipment manufacturers have had in adapting existing machinery or evolving even more ingenious implements is sufficient refutation that a " take it or leave it " atmosphere pervades the timber ports of this country.

The Advantages of Unit Loads.

A study of the programme of constructional work undertaken by forward looking port authorities, and an appreciation of the large sums they have spent on appropriate machinery, would naturally lead to an expectation of a reciprocal programme of improvements having been made within the timber trade. Whilst invention, adaptation and experiment within the port have surged forward for a decade, these forces still make their impact against the unchanging conditions under which timber continues to be imported.

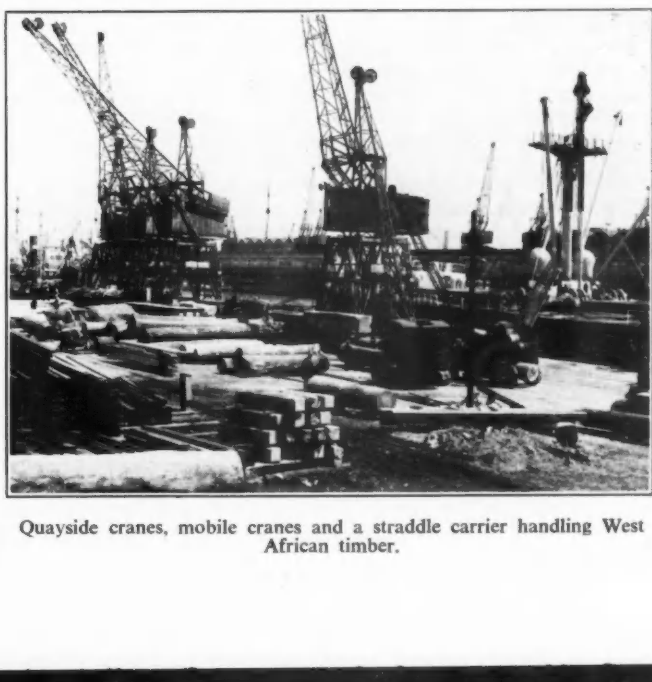
The spate of Victorian housebuilding caused the cargoes of softwood logs, landed for cutting-up in metropolitan sawmills, to be replaced by shipments of dimensioned timber. A century ago a mere 7,000,000 pieces of sawn timber came in that year, into London. In spite of a steady increase in the import figures—in 35 years they had leapt up to 33,000,000 pieces—the conditions of shipment and discharge have remained substantially unchanged. Alongside these static conditions sugar imports have been developed from hogsheads, by way of bags, to bulk; oil from casks and drums, to tankers; grain handling, from shovels and sacks, to pneumatic elevators; surely timber is the only commodity that can point to no progress in the methods either of shipping or discharge.

A single step forward would remove this reproach; the adoption of the unit load. In an earlier article a mean unit weight of 200 lbs. has been suggested. The trend in recent years among other commodities has been away from the cumbersome and the over-heavy package, as it has equally been from the over-small unit. A weight around 200 lbs. would conform with this tendency.

It has been objected that the value of timber in the Scandinavian countries and Russia is so much greater than in British Columbia and the United States—where units loads have been the rule for some time—that there is no alternative to cutting timber to the last merchantable inch. The waste that is normal in the new world could not, it is argued, be accepted in the old. Whilst the f.o.b. price might be subject to some increase on this account, surely this must be weighed against the cheaper handling costs that would adhere to the package of timber from the moment of its arrival at the ships' side. A dispassionate enquiry, to follow through the relevant stages, the important question of costs, from the loading wharf to the receiver's yard, is a major point made by Mr. G. B. Crow, in his recent article advocating this reform. Surely a trade which pays such a handsome annual bill to the piper should have some call as to the tune the shipper plays?

Leaving until later the more substantial advantages of unit packages, let it be assumed that a ship, loaded in this way, has arrived at her discharging berth. The old untidy method of dumping the cargo on the quay, there to await detailed sorting, would surely give place to a mechanised transfer of the cargo to a rear piling area. The transfer could be made, either with straddle carriers or by the mobile crane, tractor-trailer drill. If the cargo is taken overside, stowage of the barge would be a quick and simple operation; a similar celerity should attend the discharge of the barge at the wharf.

Where parcels are earmarked for immediate delivery much time would be saved, as experience with the standard sets of



Quayside cranes, mobile cranes and a straddle carrier handling West African timber.

Timber Handling at British Ports—continued

hardwood has already proved. Unit loads for storage could equally well follow the hardwood piling system; a few cross bearers of suitable size would ensure a stable pile. It has, however, been objected that softwood often requires long term seasoning; before sticking could be inserted between each tier the unit loads would have to be broken up. This is quite true but the difficulty is imaginary. For many years European wainscot oak, cut to various thicknesses, and imported in the form of boules and billets, has arrived securely wired or banded. This type of timber is invariably sticked; the identity of each boule or billet is maintained without difficulty in the pile. Breaking the bands is a simple and inexpensive operation. As a matter of some relevance, after the First War, a Wool Bands Committee was formed in London to dispose of the bands removed from bales of wool opened for show purposes. A useful sum was, over a period, realised from this source. The experience gained at that time might have some value to-day, should the banding of timber units involve a merchantable quantity of metal.

The loss of valuable shipping space is often quoted by the opponents of the unit load. It is true that the smaller your unit and the less regard you need have for labour costs, the more economically can the stowage be performed, whether it be a ship's hold or a dock shed. To consider the other extreme, where the unit of stowage is a loaded lorry, a trailer or even a railway wagon, it has been conclusively proved that stowage space lost on the "roll-on, roll-off" ship, is more than made up in the quicker turn-round and the very reduced terminal charges. When it has been found that two ships, imperfectly loaded (by past standards) can do the work of three ships that have been loaded without the loss of a single cubic foot of space, conventional ideas of values have some need of revision.

What benefits would accrue from the increased speed of loading and discharge of unit loads, accompanied by the quicker clearance of berths? Firstly, calls on the demurrage fund would be less as the delays to ships decreased. There must be few ways of spending money that can bring less satisfaction than paying demurrage in any form. Secondly, the heavy annual loss that the trade now accepts as an inevitable accompaniment to the piece traffic—that of timber lost overboard in dock—would no longer be incurred. Lack of care in discharge, barges bumping against each other in a congested dock or whilst swinging in the stream, account for a sizeable quantity of "driftwood" during each season. Dock undertakings have had to shoulder the unsatisfactory and expensive task of attempting to recover this timber. The Receiver of Wrecks in each timber port knows only too well the extent of the problem. The immediate loss, or at best, the deterioration of a proportion of its imports, which is regarded as unavoidable under the present conditions would have no excuse for continuing under the unit system. Every piece of driftwood represents a shortage on a Bill of Lading quantity. When the losses inherent in the present method amount, as they may well do, to a considerable number of pieces from one parcel, the loss is serious. Claims are frequent and premiums are based on the certain losses that the present methods must perpetuate. The third advantage that would follow unit loading would certainly be the elimination of the vexatious shortages that are such a prolific source of wasted time and money.

It is now generally accepted that the rate of shipping turnround and the efficient and cheap handling of goods within the docks is a pertinent factor in determining the cost of living in all maritime countries. Timber enters so largely into the communal life of this country that the replacement of the present methods, wasteful as they have been proved over the years, can hardly be long deferred.

Hydraulics Research at Wallingford

D.S.I.R. Report for 1956

The Report of the Hydraulics Research Board, entitled "Hydraulics Research 1956," was published last month by the Department of Scientific and Industrial Research (H.M. Stationery Office, price 4s. 6d., or by post 4s. 9d.).

During 1956, the Report states, the Main Hall of the Research Station at Wallingford has been brought almost fully into use by the construction of models for the investigation of problems concerned with the behaviour of rivers, estuaries and harbours. The comparatively small area that remains free in the Main Hall is likely to be filled by models now under construction. The investigations in hand are concerned with waterways and installations not only in this country but in many part of the world.

Work on current problems represents four-fifths of the activities of the Station. The remainder is concerned with the study of fundamental problems in loose boundary hydraulics. These investigations are carried out mainly in an outdoor wave basin, in the 5-ft. flume or the 12-ft. channel.

The Investigation of Coastal Erosion.

The Station is investigating problems of coast erosion by means of surveys and by using models in the laboratory to learn more about the factors which govern the movements of silt and the building up or erosion of our foreshores.

The radio-active tracer technique, which was used successfully in following the movement of mud in the Thames estuary, has been tried out on pilot scale for coastal research. The experiment, which was the first of its kind to be carried out in this country, took place off Sandbanks, Poole, between September, 1955, ond January, 1956. The tracer used was scandium -46 incorporated in boron-free soda glass which was ground to the same consistency as that of the local sea bed. After the radio-active material had been deposited, its subsequent movements under the influence of tides and currents were traced by three Geiger counters mounted on a specially designed sledge which was towed over the sea bed by the survey boat. The experiment showed that the tracer technique could be used for following the movements of sand under coastal conditions.

Siltation in the Tidal Thames.

The Station has established, by means of surveys and models, that material dredged from the tidal Thames and dumped at the seaward end of the estuary is carried back upstream by tidal currents and deposited in the reaches immediately below the Royal group of docks. It has been recommended to the Port of London Authority therefore that this material should not be dumped in the estuary but should be disposed of by pumping it ashore.

Navet River, Trinidad.

The Station has also made recommendations regarding the design of a spillway for a reservoir to be formed on the Navet River, in Trinidad. The design is somewhat unorthodox and in its original form may have resulted in a failure of the structure but the modifications suggested will ensure that it functions correctly.

Instrumentation.

Research requirements have led to the development of several ingenious instruments. A Bed Level Plotter, for recording the changes in the contours of the beds of models during flow experiments, will follow the contours of the beds without touching them. The shape of the contour is recorded automatically. The probe moves above the bed being recorded and maintains a fixed distance above it to reproduce the contours.

A Controlled-Weir Tide Generator has been designed as a flexible apparatus for reproducing a wide variety of tidal flow patterns in models of rivers and estuaries.

Readers will recall that the main work in progress at the Station was fully reviewed in the December, 1956, issue of the "Dock and Harbour Authority." The article gave details of the work being carried out in connection with Portsmouth Harbour, Eyemouth Harbour, the tidal reaches of the River Trent, the Shrewsbury Flood Relief Scheme, the Humber Wave Wall, the Mersey Estuary, Erosion and silting in estuaries, Tema Harbour, Trinidad, and the Karnafuli River, East Pakistan.

The Trailership v. The General Cargo Vessel

Roll-on, Roll-off Method Reviewed

Many experiments have been made in transporting cargo across the seas loaded in trailer-vans and railway wagons and an interesting study of this method has been made by the Maritime Cargo Transportation Conference—U.S. National Research Council. In November last this body organised a symposium in Washington on "Roll-on, roll-off" sea transportation, at which seven papers were read. The first two were presented by members of the M.C.T.C. staff, the remaining five by representatives of other organisations, including trailership users.

Since the first two papers together make a direct comparison between trailership operation and that of the conventional general cargo vessel, they deal in the main with first principles. Extracts of these are therefore given below.

Paper No. 1: **"The principles of trailership operation"** by R. P. Delrich.

"Let us look at some of the operational principles which have become apparent to us in our study," the author begins. "Most of these are not new. Many of them find their origin in the rules governing intelligent materials handling. Some of these principles are violated in the trailership system. But where violations occur, the infraction is overcome by adherence to a rule of greater importance which results, in the final analysis, in a superior system at a lesser cost.

"It should be stated here that our interpretation of the following rules is based upon a comparison of a pure trailership, employing regular over-the-road semi-trailers, with a conventional cargo ship of similar size and speed characteristics.

"The most prominent principle upon which the trailership operates and capitalises is:

The Terminal Time Principle, which states: Maximum economy in the shipping system is obtained by reducing the terminal time of the transporting vehicle.

"This is a very simple statement; almost a truism. But it is also true that this simple rule is the most important single factor controlling the effectiveness of the trailership. This rule is the determinant of the comparative capability, expressed in terms of measurement tons per day of voyage, of the two vessels. Because of the relatively short terminal time ascribed to the trailership, as compared to the greater amount of time the conventional ship spends at the terminal, the capability of the conventional cargo ship is considerably less. The greater capability of the trailership results in a reduced cost per ton transported. Assuming sea time for both vessels of approximately the same duration, the measure of the effect of terminal time on each is expressed as tons handled per hour of vessel on berth time. Our later quantitative illustration will enlarge on this point.

"The principle of terminal time is also applicable in the case of the overland tractors. The tractor spends a minimum amount of time in the receiving and delivery functions at the tidewater terminal. Because of the nature of the trailership system, the tractor need not be tied up by receiving congestion or delivery confusion, as is so frequently the case in the conventional terminal. In a full trailerload operation, the delivering tractor need only to roll to his designated parking spot, release his trailer and be off on another profitable pursuit.

"The terminal time rule is violated by the manner in which the trailer is used. The trailer unit accumulates a considerable amount of terminal or wait time. However, this violation is relatively small when measured in dollars. It also permits the exercise of other operating principles which wipe out this apparent disadvantage.

"The second operational principle is:

The Principle of Lost Space, which promises that economy is obtained as the ratio of lost space to load carried is reduced.

"The most obvious violation of this rule is committed by the trailership. Where the conventional ship experiences broken stowage in the neighbourhood of 15 per cent., the underdeck lost space of the trailership is in the neighbourhood of 5 times that amount. But profit is not made without investment, and in this case, the trailership invests its space in order to obtain the advantages of fast turn-round. Lost space is the price the trailership pays for time gains.

"A considerable amount of attention has been given by trailership candidates to the question of 'wheels' or 'no-wheels.' The trailer size van, without wheels, decreases the ratio of lost space to load carried, true, but this is not without some cost to the system. This is a question to which our future researches will devote more attention.

"The third rule of trailership operations may be captioned:

The Principle of Unit Size. This rule states that economy in handling is obtained as the size of the handling unit is increased.

"There is no doubt that the trailer is a much larger 'draft' than the average general cargo draft size employed in loading and discharging conventional ships in all ports of the U.S. One of the conclusions of our recently completed analysis of cargo ship loading is that the draft size in general use to-day is far too small. As the unit size is increased, the man handling is reduced, and productivity is improved. As productivity improves, costs decline. This is one of the methods by which the much desired reduction in terminal time is obtained.

"This rule not only applies to the actual loading and discharge of the vessel; but it also applies to the receiving and delivery functions. Instead of handling hundreds of small units per shipment, each shipment is handled in full trailer load lots. Receiving and delivery are reduced almost to the point where the transfer of invoices and receipts require more time and effort than the transfer of the goods from one carrier to the next.

"The fourth principle is a well-established rule of materials handling and is called:

The Mechanical Equipment Principle. This rule states that economy in materials handling is obtained as the use of mechanical equipment is increased.

"This rule is, of course, not without limitation. The law of diminishing returns works to establish the outer limit of economical use of mechanical handling equipment. It has the effect, however, of reducing the amount of costly labour required, and in conjunction with the unit size rule, makes attainment of fast turnaround for the trailership a reality.

"The type of mechanical equipment employed in the trailership system varies from the yard mule and stripped down tractor to elaborate mechanical conveyor systems. Where the type of equipment may vary, they all have one thing in common; that is, rapid and economical transfer of goods from the farm area to the ship, and vice versa. They accomplish this by providing:

1. Steady flow of material at low cost by the handling of large units with a minimum of manpower.
2. Increased productivity through reduced handling of materials.
3. Increased speed of movement of the goods.
4. Increased efficiency through the reduction and elimination of back-breaking labour, thereby reducing fatigue among the labour force.

"The next principle is logical if not entirely supportable quantitatively. It is:

The Loss and Damage Principle, and states: reduction in the amount of cargo lost and damaged is obtained as the handling of materials is reduced and the integrity of the unit or package is maintained.

"Our recently completed pilot study on the subject of cargo loss and damage in the conventional shipping system reveals that the experience of one prominent intercoastal operator is an average financial loss of a dollar and a quarter per measurement ton of cargo carried. This is no small item. If we can, for the moment, assume that most of this loss and damage experience is the result of the multi-handling and exposure to pilferage encountered in the conventional system, it certainly appears that the large unit concept embodied in the sealed trailer-load can do a great deal to reduce this item of cost. One loading and one discharge of the trailer decreases the exposure to loss and damage through handling by a factor of 3. From a minimum of six handlings in the conventional process, the cargo moving via trailership is handled only twice.

The Trailership v. The General Cargo Vessel—continued

"Exposure to pilferage is virtually eliminated where the goods are stored under seal in the trailer, as compared to the pilferage susceptibility of the same merchandise exposed in the transit shed.

The Principle of Flexibility, which is the sixth rule, states that economy derives from the use of equipment which is capable of a variety of uses.

"This adaptation of an established materials-handling principle is applied to the trailer in a number of instances. The trailer has many functions in addition to its primary mission of overland transportation. In the terminal it provides covered storage for the merchandise; in the loading process it is the cargo draft; at sea it provides the protection against shifting loads to the cargo it contains; it is the guardian against broaching and pilferage; it is also the substitute, in some cases, for expensive export packaging required for the containment of certain commodities. There can be no doubt that the flexibility of the trailer has been used to the maximum of the trailership system.

"If this principle is violated, it is probably violated by the trailership itself. The ship has lost some of the flexibility attributed to the conventional cargo carrier. It is restricted to movement between ports which are equipped to accommodate the peculiar unit it transported. It is also restricted in the types of cargo it can carry. It cannot, without some alteration, perform its war-time function with the same degree of independence as its conventional counterpart.

"Another principle which evolves from the trailership system is:

The Terminal Through-Put Principle which provides that as the terminal time of the ship is reduced, the annual through-put capacity of the terminal is increased.

"Pier C, in Hoboken, one of our most modern terminals, cost about $6,000,000 to construct. It has an annual through-put capacity based on the average turn-around of its user ships, of about 300,000 long tons per year. The New York Port Authority has plans calling for the construction of a two-berth trailership terminal at Port Elizabeth which will cost about the same as the Hoboken Terminal. However, based on a conservative estimate of 2 sailings a week from each berth and only 5,000 long tons of cargo per sailing, loaded and discharged, a through-put average of 1,000,000 tons per year is possible. It goes without saying that as the through-put of a terminal increases, the terminal cost per ton is reduced.

The last principle which is apparent to us is the Principle of Safety. This rule states that cost is decreased and productivity is increased as safe working conditions are provided.

"Our study of Longshore Safety, recently released by the Academy, states that the greatest number of accidents incurred by longshoremen result from the hand-handling of cargo. Falls and moving objects are next in the order of most frequent accident types.

"The trailership type of operation should do much to reduce the number and severity of accidents among the personnel involved in the system. Hand-handling of cargo is virtually eliminated from the system. Whether the falling habits of longshoremen can be curbed, or whether the substitution of a tractor for a swinging draft can reduce the other types of accidents is something that we can only hope for.

"If the trailership system can reduce accidents to a significant degree, not only should this result in improved efficiency and reduced operational cost, but also result in an eventual whittling down of the current compensation costs currently plaguing the stevedore industry."

The complementary paper to this, by V. A. Lewinson, was entitled: **"Numerical Illustration of Trailership Operation."**

"After Mr. Delrich's exposition of principles," states Mr. Lewinson, "I shall work out a numerical example, using reasonable estimates of the quantities involved in a likely general situation. The purpose of this is to illustrate the principles and to show which are the more important factors in the situation. We will try to show how vital the unit-size and mechanical-equipment principles are for the trailership; how the length of the voyage affects the contest between the terminal-time and lost-space principles; and how overwhelming is the importance of the ship cost, the cost of both construction and operation, in roll-on, roll-off, especially for longer voyages.

"Our idea is to compare a conventional ship and trailership carrying general cargo in round-trip service between two ports which are in one case 1,000 miles apart, and in another, 4,000. We shall consider a through roll-on, roll-off movement, with no consolidation or transfer in the receipt and delivery functions. However, we shall exclude overland transportation from consideration since this segment should not differ greatly between the systems.

"First, let us discuss what assumptions to make about the vessels. It seems reasonable to choose a new conventional ship to compare with a new trailership, so (see Table 1) we shall talk about a Clipper, the new MARAD C3 design, and about a trailership of the same speed and slightly lower capacity (300 trailers containing 10,000 MT net cargo vs. 13,000 MT net payload for the Clipper). These two would have about the same construction cost and not too widely different operating costs. The principal item in the difference at sea is fuel consumption. Besides the cost of building and operating the trailership itself, we must add in the trailers at $5 per day each. The trailers have a triple function: moving cargo at sea, transporting it overland, and storing it in the marine terminals. One set of 300 trailers will be at sea; that costs $1500 per day. When the ship arrives in port, another set of trailers, already full of outbound cargo, must be waiting in the terminal so that the loading of the vessel can proceed without delay. We do not know exactly how to divide up the trailer's time ashore between profitable overland movement (which, as I said, we do not include in either system) and unprofitable waiting in terminals. This is an interesting problem of scheduling, which we are beginning to study. For to-day, we assume that a trailer will lose on the average 3 days of its time ashore in each port, one day waiting for the vessel, one day being loaded or discharged, and one waiting to be cleared from the port.

TABLE I. COMPARISON OF VESSELS

	CLIPPER	RORO
Speed	18 k.	18 k.
Payload (capacity)	13,000 MT	10,000 MT
Construction Cost	$10,500,000	$10,500,000
Per diem operating cost		
In port	$2300	$2500
At sea	$3400	$4000
Trailers	———	$1500 plus

"The other most important group of assumptions in our example deals with stevedoring. For the conventional ship, we assume that both ports have a straight-time wage scale of $65 per gang hour, a middling figure for the U.S., and a productivity of 45 MT loaded or discharged per paid gang hour; according to our Loading Study, this is perhaps a little better than middling. To speed the turn-round, we will use as many gangs as possible, a maximum of 9, and work 1 and ½ shifts per day (8 hours straight time, 4 hours overtime). The guess for the trailership is a very rough one, but luckily it is a rather small element in the system cost. We have assumed a complete discharge and loading by 4 longshore gangs of about 20 men each in 8 working hours. We figured that $100 per gang hour would cover the longshoremen's wages and the cost of the tractors used in the ship discharge and loading.

"There are some other assumptions, but I shall explain them later, as they become necessary. We are ready to look at some of the results. Let me remind you again that they are rough comparisons of hypothetical situations, not based upon measurements of any particular trade.

"Table 2 shows the capability of the vessels, the number of thousands of MT transported per year of 330 working days. I have included one day for delays in each leg of each voyage. By 'load factor' I mean the ratio of cargo carried to the maximum that might be carried, averaged over one or more voyages. For instance, if the Trailership has all its 300 trailers full in one direction, but half of them are empty on the return leg, the load factor is 75 per cent. for that voyage. For the 75 per cent. load factor, the Clipper moves 19,000 MT net cargo per round voyage, against

The Trailership v. The General Cargo Vessel—continued

15,000 for the trailership. Over the shorter voyage, however, the Clipper takes twice as long, so the roll-on, roll-off ship has an advantage of 50 per cent. in cargo transported per year. In this case, the terminal-time principle has won out over the lost-space principle. Now, if we go to the 4,000-mile voyage, the tug-of-war is about a draw—210,000 and 220,000 MT per year. Of course, the longer the voyage, the less important is the terminal time and the more important is the payload.

TABLE 2. COMPARISON OF CARGO TRANSPORTED

Clipper vs. Trailership

	75% Load Factor		100% Load Factor	
	Clipper	RORO	Clipper	RORO
MT per voyage	19,000	15,000	26,000	20,000
Voyage days (1000 miles) ...	16	8	18	8
Cargo per year (thou, MT/yr.)	400	620	470	820
Voyage days (4000 miles) ...	30	22	32	22
Cargo per year (thous. MT/yr.)	210	220	260	300

"Again looking at the lower load factor (on Table 3) 19,000 MT of net cargo are handled in one discharge and loading of the Clipper, against 15,000 for the trailership. This requires 430 ganghours against only 32 for the trailership, so the roll-on, roll-off vessel enjoys an advantage of almost a factor 12 in productivity. This illustrates the operation of the unit-size and mechanical-equipment principles. This second comparison relates these rules to the terminal-throughput principle. The Clipper is on berth 110 hours, against 12 for the trailership, so roll-on, roll-off moves 7 times as many MT of cargo per hour on berth.

TABLE 3. COMPARISON OF STEVEDORING PRODUCTIVITY

Clipper v. Trailership

	75% Load Factor		100% Load Factor	
	Clipper	RORO	Clipper	RORO
MT Handled	19,000	15,000	26,000	20,000
Gang-hours	430	32	570	32
MT per GH	45	470	45	620
Hours on berth	110	12	130	12
MT per hour on berth	180	1,200	190	1,700

"The next table (No. 4) introduces the dollar sign. The vertical scale is the cost in $/MT to carry cargo through the parts of the system shown. This table assumes a load factor of 75 per cent. The left-hand two bars on the table are the cost for the Clipper and the trailership at a one-way distance of 1,000 miles; the other two, at 4,000 miles. The lowest part of the bar corresponds to the Loading Segment; the next part to the Costs at Sea; the part above that, which is just like Loading, is the Ship Discharge Segment. Above that comes R and D, Receipt and Delivery, comprising the cost of emptying outbound cargo from the land vehicle and of placing inbound cargo into another one at the other end. There is no corresponding entry for roll-on, roll-off because we assume a pure through-move with no consolidation; it would not be difficult to correct this table for any expected fraction of cargo requiring transfer to seagoing trailers. The top part of the bar, L and D, represents the cost of cargo Loss and Damage. We recognise that we have omitted some elements of the systems; I shall enumerate some of them later.

"Over this part of the system, then, there is a large transportation cost advantage for the trailership ($4.60 against $11.80) at the short distance, and a smaller advantage ($11.70 vs. $15.80) at the 4,000 miles distance. On this basis, the costs will be equal somewhere around 8,000 miles.

"Let us examine the various elements of the segments. The whole cost of the Loading and Discharge Segments is so small for the trailership that the artist wasn't able to divide it up on this table. The first part is the cost of the terminal itself; then comes stevedoring; next, 'A and I,' standing for Amortisation (20 years) and Interest (4½ per cent.); and, finally, the operating cost of the ship on berth. Amortisation and Interest is based on the entire $10,500,000 cost of the ship. Overall, loading amounts to $3.40 for the Clipper and 90 cents. for the trailership.

"The cost at sea is divided up into the actual operating cost and 'A and I' again. For the trailership, there is also an item for the trailers. In the short voyage, these costs are $1.50 for the Clipper and $2.50 for the trailership. At 4,000 miles, these have increased to $5.50 in the conventional system and $10 for roll-on, roll-off.

"The Discharge Segment is just the same as the Loading Segment, so I won't repeat. As for these upper two items, we think Receipt and Delivery cost about $2.30, and Loss and Damage about $1.25, in the conventional system. For a roll-on, roll-off ship we estimate, on the basis of what little information we have obtained, that Loss and Damage may amount to one-fifth of the conventional figure, or 25 cents.

"The purpose of this table, however, is not to emphasise the details but the large features. First, we see the importance of the ship itself in the roll-on, roll-off system. Even at the shorter distance, the cost at sea is predominant, and at 4,000 miles you can hardly find anything else. This means that a potential trailership operator, especially one contemplating a long haul, should probably put a large fraction of his research effort into finding a ship design which has the best payload, speed and costs for his own trade. A gadget which saves even half his stevedoring costs would be useful, but unimportant compared to a saving of a few percent. in ship operating or construction costs. At this stage, the operator must find out quantitatively how the lost-space and other principles balance in his own situation.

CLIPPER AND TRAILERSHIP – 1000 AND 4000 MILES – 75% LOAD FACTOR

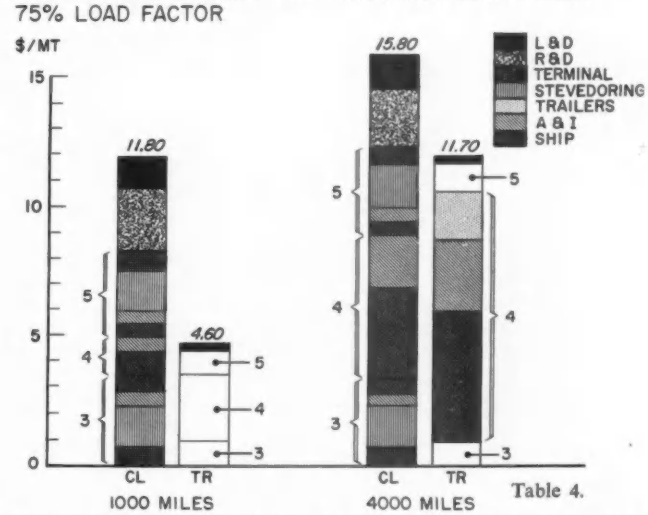


Table 4.

"It is interesting to note how this conclusion of our first roll-on, roll-off study differs from that of 'The Warrior,' our first study of the conventional system. 'The Warrior' focussed attention on the stevedoring function as offering the greatest opportunity for improvement of the conventional system. We think roll-on, roll-off meets this challenge so successfully as to shift the principal emphasis elsewhere, to the ship costs.

"The other thing that strikes me about this table is related to the unit-size and mechanical equipment principles. See how many important cost items in the conventional system are related to the break-bulk process, and are greatly reduced in the roll-on, roll-off system—the terminal itself, stevedoring, receipt and delivery, loss and damage—each in the range of $1.25 to $3 per MT for complete transfer from shipper to consignee. One should mention accidents to personnel here, too, for most of them are caused by break-bulk handling.

"Now, let me enumerate some of the elements we have omitted in this example, generally for the lack of data.

"First, the roll-on, roll-off system offers packaging savings to the shipper, especially if he can load the seagoing trailer at his own warehouse. This is another case where savings result from decreased break-bulk handling

"Second, the lost time of truck and driver waiting to be loaded or discharged should be less via roll-on, roll-off than in the conventional system.

The Trailership v. The General Cargo Vessel—continued

"I have already mentioned longshore personnel safety effects, although we have not included them quantitatively. Let me merely name some others:

1. Legal problems—customs inspection and road laws, for instance.
2. Problems of overland transportation, availability of roads and tractors, etc.
3. Labour attitude to a mechanised system.
4. Overhead.
5. Intraport movements, and storage costs in marine terminals.
6. And, finally, effects of multiport operations, delays and detentions, and similar complications of both systems, plus all the unexpected difficulties which crop up in setting a new system in motion."

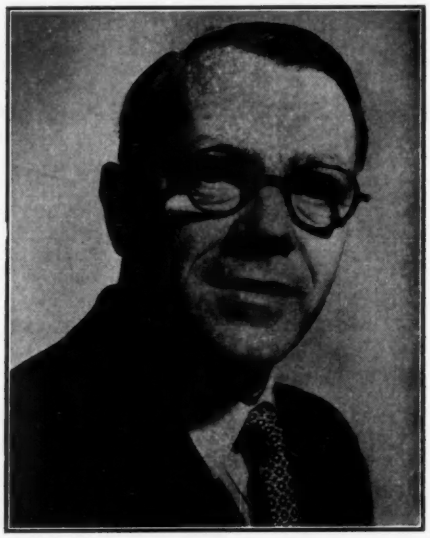
"To summarise briefly: Mr. Delrich discussed some principles, many of them materials-handling principles, related to trailership. Among the most important are the terminal-time, unit-size, mechanical-equipment and lost-space principles. I have given a numerical example to illustrate some of these principles. The example is intended to show the magnitude of various break-bulk handling costs in the conventional system, and how much less they may be for trailerships. The example also emphasises the importance of ship design to the roll-on, roll-off system, even more than the conventional system."

The development of trailerships is not an isolated occurrence. It is part of the world-wide movement away from the traditional methods of handling and transporting goods as separate packages. Unit loads, with or without pallets, have been slowly but surely bringing about revolutionary changes in packaging and in vehicle and premises design and will in time make necessary fundamental alterations in the design of the conventional general cargo vessel. The growing container traffic is another indication of the same trend. In whatever direction these requirements finally lead, there can be no doubt that in, say, twenty years' time, the types of traffic with which ports have to deal and the way they must be handled, both on ship and on shore, will be very different from what they are to-day.

Notable Port Personality

N. A. Matheson, M.I.C.E., M.I.Mech.E.

Born in 1907, Mr. Matheson received his education at the Robert Gordon Colleges, Aberdeen, and, on leaving school, served his pupilage as a civil engineer with the Aberdeen Harbour Commission. Thereafter he went for a short time as assistant engineer with Messrs. Henderson and Nicol, Consulting Engineers, specialising in harbour and river improvement works.



In 1930 Mr. Matheson was appointed Senior Assistant Engineer to the Isle of Man Harbours Board under the late Mr. W. H. Blaker and Mr. J. C. Brown and five years later, he was made Chief Engineer to the Greenock Harbour Trust. In 1940 he was appointed Chief Engineer to the Dundee Harbour Trust, and also assumed the duties of General Manager of that Port from 1942 onwards. During his period of service at Dundee, he acted as consultant to the Caledon Shipbuilding and Engineering Company, Ltd., in connection with the construction of a deepwater fitting-out jetty. In 1947 Mr. Matheson became Engineer-in-Chief to the Port of Bristol Authority, which position he has held until the present time.

Mr. Matheson was Chairman of the S.W. Association of the Institution of Civil Engineers for the Session 1954-55, and has been a member of the Dock and Harbour Authorities Engineers Sub-Committee since 1947. He is at present acting as a representative on the Organising Committee, and is Chairman of the General Purposes Sub-Committee for the XIXth International Congress of the Permanent International Association of Navigation Congresses to be held in London in July, 1957.

In 1956 Mr. Matheson delivered a paper to the Institution of Civil Engineers as part of a symposium on General Cargo Handling and his name is well known in connection with articles he has contributed in the past to this and other technical publications.

Canadian Harbours

Summary of Annual Report of National Harbours Board

The National Harbours Board of Canada has recently published its 21st Annual Report which covers the operations for the calendar year 1956 of the harbours of Halifax, Saint John, Chicoutimi, Quebec, Three Rivers, Montreal, Churchill and Vancouver, and the Government grain elevators at Prescott and Port Colborne.

During the year harbour traffic surpassed all previous records and revenues and expenses were higher than in the previous years. Water-borne cargo exceeded 50,000,000 tons, being 8,000,000 tons, or 19 per cent. over the figure for 1955. Grain traffic showed an increase rising from 9,805,710 tons in 1955 to 13,460,731 tons, an increase of 3,655,021 tons or approximately 37 per cent. Considering other commodities with aggregate tonnages in excess of 200,000, there were increases in fuel oil, crude petroleum, gasoline, pulpwood, crude gypsum, logs, cement, sand and gravel, raw sugar, asbestos, iron and steel bands and bars, motor vehicles and parts, ores, oil cake and meal, grain products except flour, iron and steel scrap. Decreases were shown in bituminous coal, lumber, wheat flour, newsprint and woodpulp.

Operation income rose by 14 per cent. to over $24,000,000. Operation expenses increased by 19 per cent. to over $14,000,000. Net income was $2,304,000, exceeding that of the previous year by $282,000. Foreign inward traffic increased 2,019,775 tons or 22 per cent., and foreign outward traffic increased 4,548,258 tons or 36 per cent. compared with 1955. Domestic traffic inward increased 487,160 tons or 4 per cent. and domestic outward increased 999,517 tons or 14 per cent. compared with 1955. Vessel arrivals in 1956 numbered 51,583, the aggregate net registered tonnage being 50,355,977. The comparable figures for 1955 were 50,081 vessels, an aggregate tonnage of 46,693,486 net registered tons.

To provide for growth in traffic and to meet special requirements arising out of the construction of the St. Lawrence Seaway, a large programme of capital works is being carried out. Actual expenditures in 1956 amounted to $13,000,000. Work under contract and uncompleted at the end of the year represented an additional outlay of $14,500,000.

Major construction projects completed or in progress during the year included new or improved wharves at Halifax, Quebec and Montreal, transit sheds at Halifax, Saint John and Montreal; improvements in grain loading facilities at Halifax; changes and additions to the grain elevator system at Montreal; installation of grain elevator equipment and additional oil storage tanks at Vancouver; completion of one additional traffic lane and improvements of the south shore approaches, Jacques Cartier bridge; dredging to improve and create new channels at Montreal.

Capital expenditure totalled $13,021,888. Of this amount, $11,743,792 was obtained from Borrowings; $225,571 from Replacement Funds; and $1,052,525 from Revenue.

The Baltic Maritime Conference

Review of Recent International Meeting

(From our Special Correspondent)

The Baltic and International Maritime Conference, known popularly as the "Baltic Conference," met in Paris from May 20th to May 24th, when delegates from nearly 30 out of the 40 countries in which the conference has members, attended.

Mr. E. Hahn-Petersen, of Copenhagen, gave the presidential address. He ranged over a wide field of subjects affecting shipping, struck an optimistic note about the growth of world population and the consequent increased demands for the necessities of life—much of them to be carried by sea—by these new consumers, but also gave a warning about building ships beyond the capacity of world trade.

He began by pointing out that world trade had recorded a more pronounced increase during the past two years, both in volume and in value, than at any time in the post-war period. After two years of stagnation we had witnessed a distinct upwards trend from 1954, and in 1955 the seaborne world trade reached 820 million tons, against 710 million tons in 1954, an increase of no less than 110 million tons.

The exact figure for 1956 was not yet available, but it was assumed that the rise continued at the same tempo. While world trade had grown by over 10 per cent. a year during that two-year period, world tonnage expanded by about 5 per cent. a year, which to a great extent explained why the demand for shipping space had been so satisfactory.

The last pre-war figure for seaborne trade, that for 1938, was 470 million tons of goods. The totals for some of the post-war years gave the following picture:

	Tons		Tons
1950 ...	550 million	1953 ...	670 million
1951 ...	640 „	1954 ...	710 „
1952 ...	660 „	1955 ...	820 „

The background for these increases in world traffic had been:

- Growing world population.
- Expanding industrial activity, mainly in the U.S.A. and Western Europe, with an augmented demand for raw materials for energy production.
- Economic progress in the so-called under-developed countries, which were becoming more and more important as producers and consumers.

However, it was evident from the course of developments at the end of 1956 and the beginning of 1957 that some moderation in economic expansion was taking place; this applied to the U.S.A. as well as to Western Europe. The inflationary tendencies prevailing in many countries necessitated counter-measures such as credit and import restrictions.

Mr. Hahn-Petersen then turned to a consideration of the growth in the world population. He said that it was estimated to increase by about 30 millions a year, equal to some 80,000 a day, a record so far in the history of mankind. The United Nations estimated the world population to be 2,692 millions on July 1st, 1955, and to-day the figure was said to have reached 2,750 millions, of which 1,500 millions related to Asia. China had a population of about 600 millions and India about 400 millions.

If it were assumed that the population would continue to grow at the same rate in years to come, in 1963 the total would reach 3,000 millions and in 2015 the staggering figure of 5,000 millions. That would mean that the world population would have doubled within the next 60 years.

These new citizens of the world were creating a potential increase in the demand for food, clothing, housing, fuel, etc., and for sea transport of goods. However, there was a certain danger involved and the need for harmonious international co-operation would be more important than ever.

It was interesting to see how the population of the world had changed during the last 300 years. The figures were as follows:

1650	545 millions
1750	728 millions
1850	1,171 millions
1900	1,552 millions
1950	2,504 millions

Next the president dealt with the growth in world tonnage. He said it was estimated to have reached 110 million gross registered tons. In the middle of 1956 it was 105.2 million gross tons and other figures were:

1900	24 million gross tons
1914	45.4 million gross tons
1939	68.5 million gross tons
1950	84.6 million gross tons

Thus so far in this century world tonnage had been quadrupled. The most marked increase in recent years had been apparent in the tanker fleet. To-day that fleet aggregated about 30 million gross tons, double the figure for 1946 and treble that for 1939. The tendency was towards ever larger types of vessels, and in particular tankers. Within the last six years a new record had been made nearly every year. The largest tanker delivered in 1950 was 28,330 tons deadweight; in 1954 the tonnage was 46,550; in 1956 it was 85,515 and it had recently been reported that contracts had been made for tankers of up to 106,500 tons deadweight.

According to present information, the growth of the world tonnage would rise sharply in the next few years. On January 1 this year contracts had been placed at shipyards all over the world for about 29.2 million gross tons, of which tankers alone accounted for 18.5 million tons It was thus evident that they should see a considerable increase in the tonnage available in the next few years and there was reason to believe that the shortage of shipping space which was so prevalent in 1956 would prove to have been a temporary phenomenon.

As to world markets, the president said that there was every indication that world trade and world shipping in the coming years would be dominated in an ever-increasing degree by the transport of coal and oil to meet the growing demand for energy, arising from the continued industrial expansion.

Based on developments in the past five years it was estimated that by 1975 the need for energy in Western Europe would have reached, expressed in terms of coal equivalent, 1,200 million tons, against 730 million tons in 1955. Only 63 per cent. of these 1,200 million tons could be drawn from Western Europe's own production of coal, oil, hydro power, natural gas, etc., while the remaining 37 per cent. must be imported. The need for conventional fuels would exist for a long time. It was estimated that even by 1975 nuclear power would only provide 8 per cent. of requirements, and that coal would remain the most important factor in the supply of energy.

The production of coal in Western Europe was only expected to rise from 478 million to 520 million tons and Europe must therefore rely on increased imports of coal from oversea; it was likely that the total would have reached about 50 million tons by 1975.

Europe would have to depend upon oil to meet the mounting need for energy and, as no material improvement in Western Europe's own oil production could be expected, a marked increase in the imports of oil would be necessary. While, in 1955, the imports reached 117 million tons, expressed in terms of coal equivalent, it was estimated that by 1975 they would reach 315 million tons.

These figures referred to the O.E.E.C. countries, but elsewhere in the world there would also be an increased demand, but governed by industrial developments in the respective areas. On that account he believed there would be a steadily growing demand for tonnage to transport coal and oil.

From these facts and figures the president saw a likely increase in the need for seaborne traffic, but at the same time world tonnage was growing rapidly and the freight market depended on the balance between these two factors. He would be giving a wrong picture if he attempted to predict remunerative employment of available shipping space during the next few years. On the contrary, he was afraid that too much tonnage was on order to-day and shipowners, especially in the traditional maritime countries were extremely worried to see many non-shipping people—presumably influenced by the recent boom—investing money in large and expensive vessels.

The Baltic Maritime Conference—continued

They had not learned, as many of those present had, the hard lesson of the lean years. They did not realise how even a comparatively slight slackening in the demand for tonnage might seriously affect their economy. Ships were not only expensive to build, but to-day their upkeep and manning were on an altogether different scale than that of a few years ago.

The growing tendency to register ships under flags of convenience was a menace to the shipping industry as a whole and in particular to the traditional maritime countries which, incidentally, were also the principal users of shipping space. The fleets under "Panhonlib" flags had now reached about 11.5 million gross tons —over 10 per cent. of the world tonnage. It was to be feared that this tendency would continue in the coming years, especially as it was estimated that 20 per cent. of the tonnage now on order was intended to be registered under these flags.

Through virtual freedom from taxation and being under no legal obligation for social responsibilities, these shipowners had a tremendous advantage in competing with the owners of the traditional shipping countries.

Old established shipowners had never been afraid of competition in the world's free markets. In fact they welcomed competition because it helped the industrious and experienced shipowners. But it was always understood in days gone by that such competition would be on a more or less equal footing. What they were faced with to-day however, was a different type of competition which some of them felt was unfair. It meant that the flag of a vessel had less and less to do with the actual country of domicile or its owners, and was merely a kind of stamp which could be affixed or removed from the vessel as convenient.

Of the European Common Market treaty, the president suggested that this was a more permanent guarantee that the results achieved so far by the O.E.E.C. in respect of liberalisation of shipping and shipping services in Western Europe would be maintained. The Free Trade Area would also support the liberal shipping policy which had been pursued by the O.E.E.C. and might give it a strong position in continued negotiations with other countries or groups of countries.

The Free Trade Area must be judged from the point of view of the importance of strengthening the position of the whole of Western Europe in relation to world economy, with due regard to the trading areas represented by the U.S.A. and the block of eastern countries. If commercial co-operation within a European Trade Area was strengthened, it might create a more natural balance towards the dollar area and consequently contribute to more favourable conditions for a mutual and more liberal policy on trade and shipping between the U.S.A. and all the countries belonging to Western Europe.

At one of the business meetings, Mr. C. J. Edmond Moser, of Paris, gave an address on "The phosphate deposits in North Africa, how they are utilised and how the raw phosphate is shipped to the importing countries." First of all, Mr. Moser mentioned some of the industries in which raw phosphate and the products derived from it are employed: detergents, paint, glassworks and plastics, matches, textiles, petroleum, pharmaceuticals, vinification, germination (such as baking and leavening agents) and for preservation of cheese. He said that by far the most important application of the products was in the manufacture of detergents, but phosphate was also used for manufacturing certain products destined to soften boiler water, a fact which might be of particular interest for shipowners. Raw phosphate was also used for metallurgical purposes and was important in the iron and steel industry, where it was used for increasing the percentage of phosphorous in ore used for manufacturing Thomas steel.

Having thus emphasised the importance of the product—which forms one of the main bulk cargoes in to-day's tramp trades—Mr. Moser went on to explain that raw phosphate is always shipped in bulk, with the exception of hyperphosphate, or ground phosphate, which has to be bagged because the degree of fineness is such that it has the consistency of flour, making it impossible to ship in bulk. On the other hand, superphosphate—which in shipping circles is often simply described as "fertilisers"—is nearly always shipped in bags, especially when loaded on the Continent.

The production of raw phosphate is three times higher than it was before the war. When it reaches the loading ports it is stocked and the tonnage maintained at 15 to 30 days' production. The daily rates for loading stipulated in charterparties are: 3,000 tons at Casablanca, 2,400 tons at Saffi, 2,400 tons at Bona and Sfax, with only 1,000 tons at La Goulette and 900 tons at Bougie, but these latter ports are much less important than the "big four."

The loading appliances are extremely modern and are specially adapted for the loading of only one kind of mineral, i.e., raw phosphate, the loading operations being effected by conveyor belts. The speaker emphasised that the loading appliances are the property of the mining companies and are completely independent of the ordinary port equipment.

Loading operations, said Mr. Moser, are extremely fast and it is not at all unusual to see large vessels arriving at a port in the morning and leaving the same day. All loading records were beaten last year when, in December, 106,530 tons were loaded in five days at Casablanca into 29 vessels, the smallest of which was a motorship of 325 tons, others being Liberty ships and a vessel of 13,000 tons. Each of these ships, once loaded, had to be hauled off the loading tips, tugs being used in most cases, entailing for every shift a certain loss of time. He maintained, therefore, that the loading represented a "pretty good performance." In a relatively short time work now being undertaken in the port of Casablanca would allow the simultaneous loading of five vessels. As a rule, the vessels now loaded do not exceed the "Liberty size," not because it would be impossible to handle larger sizes, but because in the majority of cases the receivers would be unable to stock larger quantities.

The approximate quantities of North African phosphate exported to Europe during 1956 were:

	Tons		Tons
France ...	1,500,000	Belgium ...	400,000
Italy ...	1,250,000	The Netherlands ...	350,000
Great Britain	800,000	Poland ...	300,000
Spain ...	750,000	Sweden ...	300,000
Western Germany ...	650,000	Denmark ...	250,000

This makes a total of 6,550,000 tons out of the approximately 8,000,000 tons shipped during 1956, the balance having been shipped to other European countries such as Finland, East Germany, Hungary, Norway, Greece, Czechoslavakia and more distant countries like the Union of South Africa, India, Formosa, Japan, Brazil, Canada, Chile and Uruguay, which are also supplied by North Africa.

The figures, as Mr. Mozer emphasised, show that the North African phosphate traffic, which is covered mainly by tramp vessels, is much more important than any other Western Mediterranean traffic such as pyrites, bauxite, etc. And the saturation point in phosphate consumption in the world has not yet been reached.

The other major contribution was an address on "Shipping and the River Plate Grain Trade" by Mr. W. H. Fowler, of Buenos Aires. He reviewed all the factors which have led to the decline in the past 20 years of Argentina's importance as a grain producer and exporter. His conclusion was that recent measures, and those promised for the future, such as the restoration of the trade to private hands, should enable the country to recover her former place in the world markets.

Among other meetings was that of the Documentary Council, which was under the chairmanship of Mr. Alexis R. Anderson, of Copenhagen. Here were discussed freight contracts for coal, grain and timber shipments, and the importance of clear and reasonable terms. It was pointed out that improvements made by port authorities, and efforts made by Governments to attract trade to their respective countries could to some extent be frustrated if quick and efficient service was denied to shipowners, of the contract terms for tramp vessels were unsatisfactory, and if foreign ships in particular, their owners and masters, were not treated fairly and given the opportunity of taking full advantage of the facilities available.

New quays and new cargo-handling equipment which would enable bulk cargoes to be handled at the rate of 2,000 tons a day would be of little use to shipowners if all they could get was a discharge of 500 tons a day.

Channel Improvements proposed by the Port of New York Authority

Recommendations Submitted at the Public Hearing

The Port of New York Authority has for a number of years conducted studies and presented its recommendations to the federal authorities on the need for improvement of channels within the Port District. The results of the most recent studies undertaken by the Port Authority provide the basis for the information and recommendations given below.

Economic Importance of New York and New Jersey Channels.

The New York and New Jersey Channels is the designated name of the Federal ship channel project which extends from Lower New York Bay through Raritan Bay, Arthur Kill, and Kill Van Kull to Upper New York Bay. The New York and New Jersey Channels, together with Bayside and Gedney Channels, is an alternate deep-water entrance into the entire New York-New Jersey Port. Its course encircles Staten Island and serves as a by-pass channel for the busy Ambrose Channel and Narrows entrance to the harbour.

The existing federal project for the New York and New Jersey Channels was adopted in 1933, modified in 1935, and modified again in 1950. The present authorised project provides for a channel 37-ft. deep in rock and 35-ft. deep in soft material, with a width of 500 to 800-ft.; two anchorages 38-ft. deep to accommodate five vessels each, one in the vicinity of Sandy Hook and the other south of Perth Amboy; and two secondary channels 30-ft. deep and 400-ft. wide, one south of Shooters Island and the other in Raritan Bay connecting with Raritan River.

The banks of the New York and New Jersey Channels comprise one of the most highly industrialised areas in the United States for the storage, refining, and distribution of petroleum products. In addition, this waterway serves large chemical plants, railroads, lumber and coal terminals, public utility companies, shipyards, and other industrial plants.

The New York and New Jersey Channels is the busiest waterway in the entire Harbour. In 1955, a total of about 72,000,000 short tons of waterborne commerce was transported to and from terminals along its banks. Over 64,000,000 tons, or almost 90 per cent. of the total, consisted of petroleum or petroleum products. The tributary areas of the New York and New Jersey Channels comprise the heavily industrialised areas of New Jersey on Newark Bay, Passaic River, Hackensack River, and Raritan River, as well as the increasingly important area of Staten Island. This vast network of waterways is dependent on access provided by the New York and New Jersey Channels. The through traffic that moved on New York and New Jersey Channels between these tributary channels and the rest of the Harbour amounted to an additional 23,000,000 tons in 1955. This adds up to a total waterborne movement on this one channel of over 95,000,000 short tons, the largest volume of tonnage of any waterway in the United States. During the five year period 1936-1940, when the channel had a controlling depth of 30-ft., it handled an annual average of close to 44,000,000 short tons. Five years later during the period 1951-1955, after most of the channel had been deepened to 35-ft., this volume had increased to over 72,000,000 short tons.

* Extracts from Report of the Port of New York Authority at the U.S. Army Corps of Engineers' Public Hearing on the New York and New Jersey Channels Project, March, 1957.

National Defence.

In World War II, the petroleum refineries and other industries on the New York and New Jersey Channels supplied the fuel oil that kept the Atlantic fleet and merchant ships in action and provided the fuel and other raw materials for the war plants in the New York-New Jersey area.

Of the greatest significance to national defence is the fact that the New York and New Jersey Channels project provides a second deepwater entrance from the Lower Bay into the entire New York-New Jersey Harbour. The value of this deep waterway to relieve the heavy shipping activity at the main harbour entrance cannot be overestimated, particularly during times of national emergency. Warships, troop transports, and cargo vessels alike would have another complete means of access to the entire New York-New Jersey Harbour.

During World War II many of the Navy's tankers were compelled to discharge aviation gasoline and other highly volatile cargoes at anchorage in the midst of other shipping within the New York-New Jersey Harbour. An adequate depth in the New

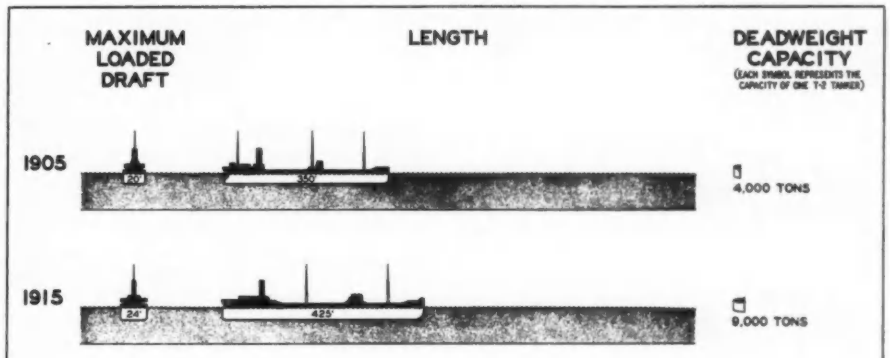


Fig. 1. Development of petroleum tanker design.

Channel Improvements proposed by the Port of New York Authority—*continued*

York-New Jersey Channels would permit even the new large tankers to proceed directly to the refineries and oil terminals to discharge or load their cargoes, and thereby eliminate this dangerous hazard to the Port.

Future Industrial Expansion.

The land area served by the New York and New Jersey Channels, especially the western shore of Staten Island, is one of the few substantial areas left in the New Jersey-New York Port region for industrial expansion where ample waterfront land and direct access by deep-sea channel are available. The forecasts of future population growth and industrial expansion in this area are based on the firm plans for improved highway connections between this area and all other sections of the Port District. The Port of New York Authority and the Triborough Bridge and Tunnel Authority are well advanced in their plans to construct a bridge spanning the Narrows between Brooklyn and Staten Island. The attending expressways leading to and from the bridge and connecting with all the major arterial highways in the area will provide the long-missing accessibility to this area that has inhibited industrial and population growth comparable to the other sections of the Port District.

The exact nature of the long-range industrial expansion is unpredictable, but it is certain to increase the volume of commerce moving on the New York and New Jersey Channels. In the future, even larger cargo ships carrying bulk iron ore, chemical products, lumber, and other industrial raw material should swell the already enormous amount of commerce and further justify the continued improvement of this waterway.

Development in the Economics of Petroleum Transportation.

The world tanker fleet at December 31, 1956, numbered almost 2,900 vessels totalling about 45,000,000 deadweight tons. The average sized vessel in the tanker fleet, considering only ships of 5,000 deadweight tons and larger, is about 17,000 deadweight tons. This is about the size of the World War II standard T-2 design.

At this same date, 960 vessels totalling about 30,000,000 deadweight tons, or two-thirds the capacity of the entire existing fleet, were on order. The average size of these new ships is 31,000 deadweight tons, or almost twice the size of the tankers now afloat. The present trend toward larger tankers is shown in the following table; and is shown graphically in Fig. 1 to have been sustained over the last 50 years.

tage of the supertanker is the improved terminal utilisation afforded by the high cargo-pumping capacity with which these modern vessels are equipped. The 45,000 deadweight ton tanker has the potential ability to deliver ashore the equivalent of almost three T-2 tanker cargoes in slightly less time than is required to discharge one war-built T-2 tanker. Full utilisation of the super-tanker pumping capacity can, therefore, substantially reduce capital investments in terminal facilities at refinery and other terminals that are faced with the necessity of handling increased volumes of crude or fuel oil, further lowering the cost of transporting petroleum products.

WORLD TANKER FLEET STATISTICS
As of December 31, 1956

Class of Ship (in deadweight tons)	*IN SERVICE No.*	*IN SERVICE Deadweight Tonnage*	*ON ORDER No.*	*ON ORDER Deadweight Tonnage*
up to 23,999	2,540	34,737,138	338	6,290,750
24,000 to 39,999	311	9,105,013	403	13,125,500
40,000 to 59,999	10	449,678	194	8,591,100
60,000 and over	1	85,515	25	1,852,600
TOTAL	2,862	44,377,344	960	29,859,950
Sub-Total, 24,000 and over	322	9,640,206	622	23,569,200

Source: John I. Jacobs & Co., Ltd., Ship Brokers, London, England.

The pace of new tanker orders, accelerated last year by the closing of the Suez Canal, has reached the point where most of the world's shipyards capable of building these mammoth ships, are now accepting orders for delivery no sooner than the early 1960's. Announcements are appearing, at times almost daily, in the newspapers and trade magazines reporting the launching of the "world's largest tanker." In 1950, when the supertanker race began, ships if 30,000 deadweight tons were being put into service; in 1954, the "World Glory," of 45,000 tons was commissioned; and last November, the 85,000 deadweight ton "Universe Leader" delivered her first cargo.

The reason behind the supertanker development in the petroleum shipping business can be summed up quite simply. According to industry sources, which have developed detailed cost figures, it costs relatively little more to operate a vessel carrying 30,000 tons of oil than it does one carrying 15,000 tons. The tendency is, therefore, to build the larger tanker, and thus reduce the unit cost of oil transportation. Another great advan-

Harbour Deepening Made Necessary by Tanker Growth.

The economic advantages of supertankers depend, of course, almost entirely on the ability of these huge ships to get into and out of the oil ports throughout the world. These potential maximum savings could not be realised in the New York-New Jersey Port District until the New York and New Jersey Channels project is deepened and otherwise improved.

The presently authorised 35-ft. channel in the New York and New Jersey Channel project allows, under existing regulations, for only those ships drawing no more than 31½-ft. during all stages of the tide, and for no more than 30-ft. during abnormal tides. It is possible, of course, for vessels of greater draft to navigate the New York and New

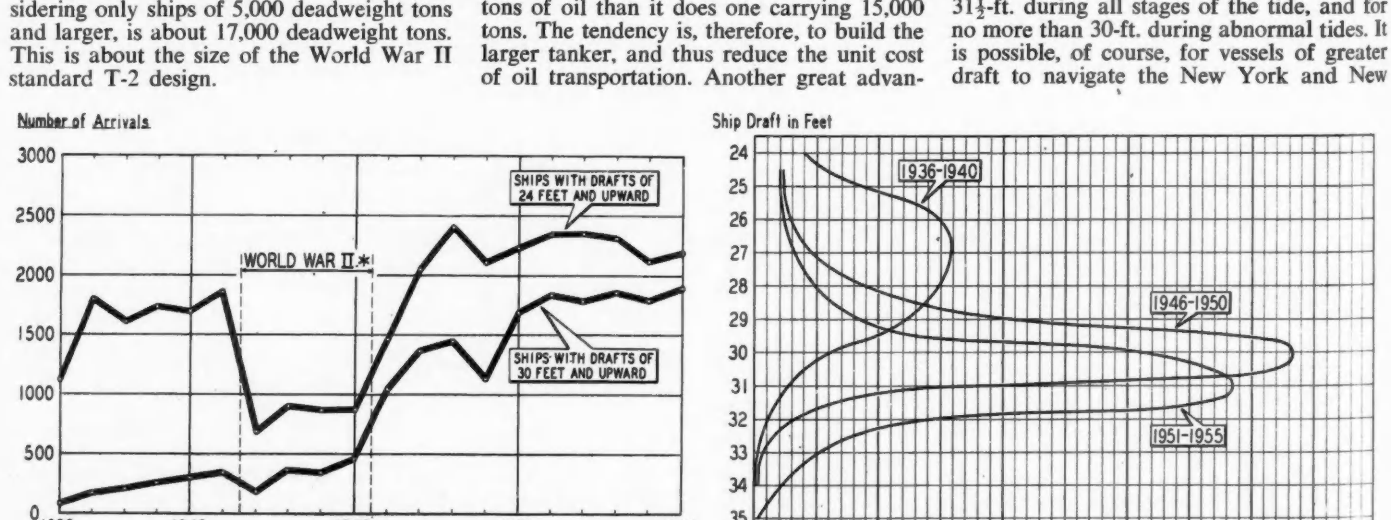


Fig. 2. Arrivals and drafts of ocean-going ships at terminals on New York-New Jersey Channels 1936-1955.

Channel Improvements proposed by the Port of New York Authority—continued

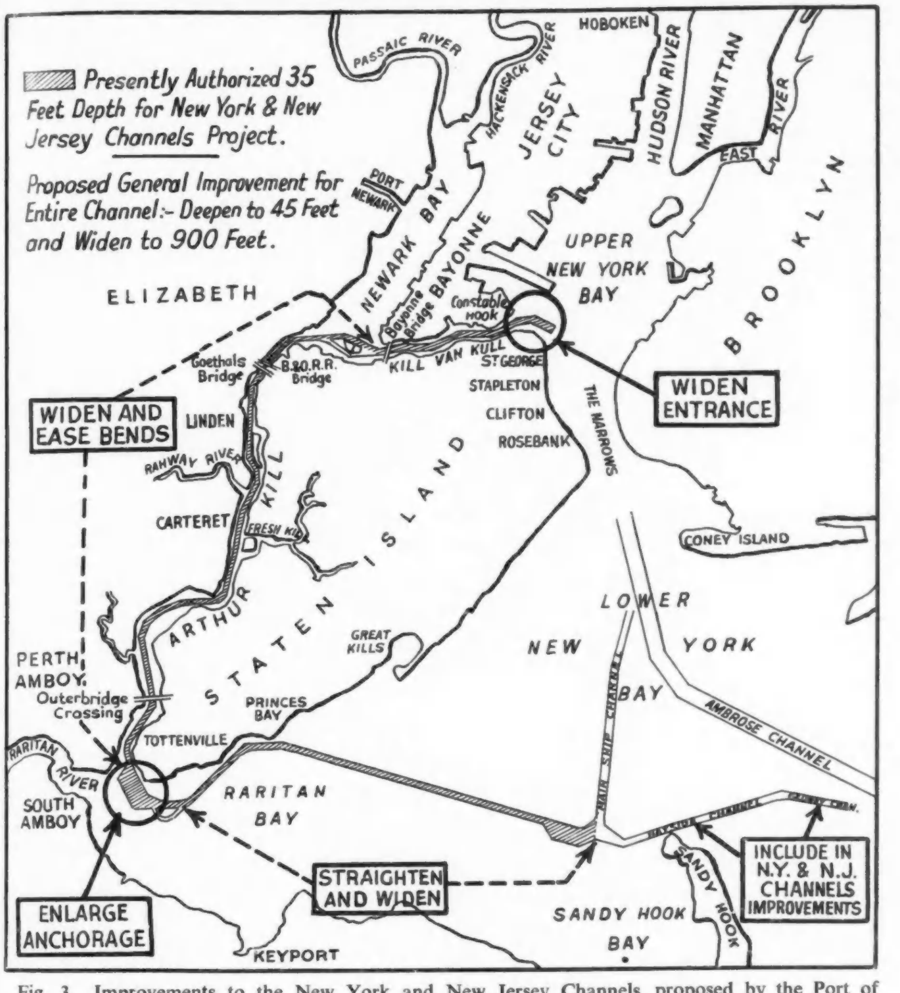


Fig. 3. Improvements to the New York and New Jersey Channels proposed by the Port of New York Authority.

Jersey Channels at high tide, but this involves costly delays in waiting for the proper tidal stages.

The consequence of this limitation can be illustrated by the example of a supertanker with a loaded draft capacity of 37½-ft. having to negotiate the New York and New Jersey Channels. In order to enter this waterway with the present draft limitation of 31½-ft., the deadweight tonnage of this vessel would have to be reduced from 45,000 tons to 35,000 tons, representing a loss of 25 per cent. of its earning capacity. This limitation is especially critical where a sizeable portion of the tanker cargoes consist of crude oil from South America and the Middle East, the long hauls that are particularly adapted to supertanker usage.

The trend in the size of vessels entering the New York and New Jersey Channels is illustrated in Fig. 2 and in view of the fact that 80 per cent. of the deep-sea vessels using the New York and New Jersey Channels are already crowding the upper draft limit of the waterway and that many of these are required to load to less than capacity, the inadequacy of the present channel depth is demonstrated.

Reports are published and constant progress is being made in the development of 32,000 ton ships, 45,000 ton ships, 60,000 ton ships, and even 100,000 ton ships for the future tanker fleet. Different classes are being designed to serve different trades and since few ships will be built to serve only one specific trade, the oil industry is attempting to design vessels that will be adaptable to world-wide service. It appears that vessels in the 40,000 to 60,000 deadweight ton range will be the largest class that will be built in any great number. Larger ships, such as the 100,000 ton tankers which have been announced recently, will be built to serve specific ports where naturally deep water is available. It would, of course, be unduly extravagant to plan all new port facilities everywhere to accommodate the largest of these new ships.

Tankers in the 40,000 to 60,000 deadweight ton class will have the following approximate dimensions:

Length	... ...	700 to 800-ft.
Beam	... ...	90 to 110-ft.
Draft	... ...	35 to 40-ft.

By applying these data to the criteria accepted by the U.S. Army Engineers, a channel must have a minimum depth of **45-ft.** and a maximum width of **900-ft.** to accommodate the ships of this class without restriction.

Recommendations.

The Port of New York Authority, therefore, has recommended that the U.S. Army Corps of Engineers consider the following improvements to the New York and New Jersey Channels (see Fig. 3):

(a) Over-all deepening of the channel to 45-ft. in soft material and 47-ft. in rock, widening of the channel to 900-ft. wherever possible, and an easing of all bends;
(b) Widening the entrance into Kill Van Kull to approximately 1,500-ft.;
(c) Increasing the size of the anchorage area in the vicinity of Perth Amboy;
(d) Providing for suitable turning basins in the middle reach of the channel, if channel width is insufficient;
(e) Straightening the Raritan Bay section of the channel to provide a more direct channel alignment from Sandy Hook to Perth Amboy; and
(f) Including the Bayside-Gedney Channel in the New York and New Jersey Channels project, with commensurate improvements.

Port Development in the Bahamas

An area, which will be known as Freeport, is being developed on Grand Bahama Island, the most northerly of the Bahamas group. The construction of a deep-water harbour is part of a scheme to turn the island into an industrial centre. The island is adjacent to the United States and the Latin American countries and a further inducement to companies to set up industrial undertakings will be the almost complete freedom from taxation for the next thirty years.

Freeport is owned by the Grand Bahama Port Authority Ltd. who have been granted rights to buy 50,000 acres of Crown Lands and some private property around Hawksbill Creek, the actual site of the new harbour. A major point in the agreement between the Bahamas' Government and the port authority was that a large seaport should be established within three years, as a shortage of shipping has always been a disadvantage to companies operating in the Caribbean.

It has been reported that the port is to be dredged to 40-ft. and will have quays sufficient for four ocean-going merchant vessels. It is probable that extensions will be made later. Further reports indicate that it is planned to build a large shipyard with a turning basin 1,550-ft. long by 1,500-ft. wide. It would have a drydock 1,250-ft. in length and be capable of handling ships of up to 100,000 tons deadweight. A channel 200-ft. wide and 32-ft. deep is to be made from the sea.

It is estimated that it will take another two years to complete the harbour, by which time the port authority expects to have a number of industrial concerns ready to establish businesses on the available land.

New Ore Handling Installation at Narvik

By JOHN GRINDROD, B.A. (Com.).

Operating Sweden's Arctic iron-ore mines, the Luossavaara-Kiirunavarra Aktiebolaget (the LKAB Mining Company) is investing about Kr. 500,000,000 (£34,400,000) in an extensive expansion programme. Initiated in 1948, the scheme is expected to be completed in 1962, and includes an almost complete reorganisation of the ore handling and shipping facilities at the Norwegian port of Narvik, through which most of the mineral from the Kiruna mines passes. The company, which, so far, has been owned jointly by the Grängesberg Group of Companies (TGO) and the State, will be nationalised as from 1st October, 1957.

As a result of this extension scheme, the output of the two main Lapland mining centres at Kiruna and Malmberget has already increased from about 9,000,000 tons in 1948 to some 14,000,000 tons in 1956. During the 1960s the output will be raised to close on 18,000,000 tons while the ultimate target is 20,000,000 tons per annum.

In the early post-war years, it was found necessary for the Kiruna ore fields to prepare to change over from open-cast to underground mining. A thorough stock-taking of the existing facilities was made and it was found that the existing handling facilities at the port of Narvik, which had been installed at the turn of the century and which had undergone very little expansion since, were in need of modernisation. This was particularly emphasised by the planned increase of output from the mines and the need for much closer classification of the ores, according to content, in view of the present tendency for iron and steel works to demand finer grading.

Taking three years to complete, the new LKAB ore storage and transport plant at Narvik, which has cost about £1,700,000, was finished in 1956 and is claimed to be one of the biggest and technically most advanced in the world. It has a capacity of 4,000 tons of ore per hour, which will make it possible to ship 12,000,000 to 15,000,000 tons of ore a year via this port.

Including quay facilities, the plant occupies an area of about 160 acres which has been leased to LKAB by the Norwegian State Railways.

Hitherto, the ore arrived at Narvik from the Kiruna mines in 35 ton ore wagons and was then dumped into 4-ton Norberg tipping cars and hauled by locomotive to storage. When the ore was taken out of storage and sent for crushing and shipment it was handled by means of shovel cranes. To cut down the number of operations and the time involved in this method of handling, the new scheme makes use of travelling loading bridges, conveyor belts and travelling bucket cranes. Not only does this save time and labour, but it ensures a steady flow of the mineral into and out of storage. Furthermore, this avoids waiting for crushed ore supplies to be replenished since two conveyor belt systems having the same carrying capacity of 4,000 tons an hour can add to or take away from the 72-ft. high stockpiles of ore at the same speed.

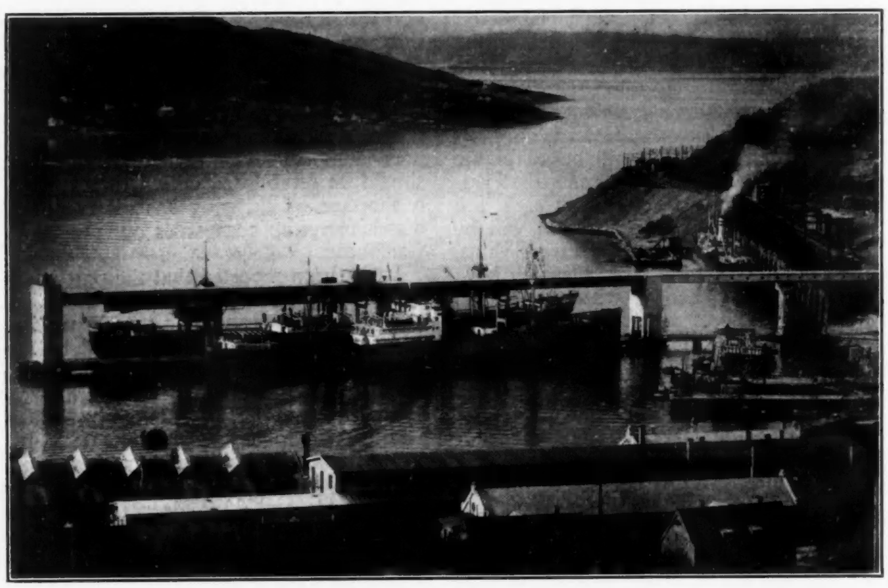
Normally, ore will arrive at Narvik already crushed to shipment sizes so that crushing will not ordinarily be necessary at the port storage yards. During spells of very cold weather, however, the ore may freeze into solid blocks which are too large to be handled by the conveyor belts. To meet such a contingency four large crushers have been installed, which will also have a total capacity of 4,000 tons an hour, and which will not only be able to crush the frozen blocks, but, so long as open-cast mining continues at Kiruna, will also be able to deal with any 25 cm. lumps of ore that may continue to arrive at Narvik from this source.

Some 2,600-ft. long by 330-ft. wide, the Narvik storage yard is enclosed longitudinally by two concrete walls which run the full length of the yard. Dividing the yard, also lengthwise, into two sections is a bridge-like structure consisting of a steel duct carried on 23 pillars of reinforced concrete, the pillars being 75-ft. tall and spaced 110-ft. apart. The dividing structure serves also as a support for the pendulum end of four travelling loading platforms and four travelling bucket cranes. It also carries two reversible 1,300-ft. conveyor belts which feed the stockpiles. The two outer concrete walls serve to support the legs of the platforms and cranes, and, at the same time, to carry the 2,600-ft. long conveyor belts by which the ore is taken from the stockpiles and delivered to a new system of belts abutting the loading quays.

On arrival at Narvik the ore wagons from Kiruna, classified as to ore phosphate content, are taken to a central unloading plant, which with a total floor space of 4,500 sq. ft. and a depth of 66-ft. has been blasted out of the rock. Here, crushing, if necessary, takes place, the ore then being taken by conveyor belts to a central point in the storage yard to be fed on to the pillar-supported distribution system. Delivery on to the respective ore piles is effected by travelling platforms provided with special distributor belts placed at right angles to the main longitudinal conveyor system.

For taking ore from the stockpiles four travelling cranes are used. With buckets of 17 tons capacity each, the ore is first placed in 70 tons capacity silos mounted in the supporting leg of each crane. These silos feed the ore through a laminated feeder on to the conveyor belts mounted in the outer concrete walls, which pass the ore forward to the shipping quay. Since each wheel of the eight-wheel crane carries a load of 65 tons, the designing of the runway on which they operate presented considerable problems and all foundations had to be taken down to bedrock. This was also the case in the construction of the pillars of the storage yard dividing structure.

Installation of the new facilities at Narvik was accomplished without interrupting the flow of ore through the port. The German firm of Demag A.G., of Duisburg, was responsible for the mechanical part of the project, while the Norwegian firm of Höijer-Ellefsen, was responsible for the concrete work.



At the old quays (shown on right) the ore is tipped from railway wagons down chutes direct into the ship. At the new pier in the foreground the ships are loaded by belt conveyor.

Refinery Expansion at Grangemouth.

It is reported that the processing capacity of the Grangemouth petroleum refinery on the Firth of Forth is to be raised from 2,200,000 tons to 3,100,000 tons per annum. This increase will approximately equal the annual carrying capacity of the 57 mile pipeline which brings crude oil to Grangemouth from the Finnart tanker terminal at Loch Long. At Finnart a new jetty, capable of taking large tankers is to be built. The overall cost of these improvements will amount to some £4 million.

Manufacturers' Announcements

Lightweight Flooring

A series of five publications describing and illustrating Q-Floor construction has recently been issued by the manufacturers, Messrs. Robertson Thain Ltd. of Ellesmere Port.

Q-Floor is a quickly erected, lightweight, cellular steel sub-floor to which is bonded a concrete topping of structural quality. The steel sections are manufactured in lengths of up to 27-ft. and in standard 2-ft. widths. Units arrive at the site bundled, ready for lifting to the required floor level. An average bundle contains 250 square feet of floor area and yet weights less than one ton.

This method of construction can also serve as a readily accessible electrical duct system for wiring, each steel cell being straight and free from any obstructions.

Demonstration of New Mobile Crane

The Jones KL 10-10 " Fast-Travel " Mobile Crane which was demonstrated recently at the Letchworth works of K and L Steelfounders and Engineers Ltd., is the first machine in the Jones range to have a capacity of 10 tons. The design is a combination of the advantages of the conventional mobile and of the lorry-mounted machine, with its high road speed. The difference between the KL 10-10 and a lorry-mounted machine are, however, fundamental. The latter consists of a lorry chassis, conventionally powered and controlled, on which is mounted a crane equipped with its own power unit and control cabin, whereas in the case of the Jones KL 10-10 the drive for all crane motions and for high speed road travel is taken from a single heavy-duty engine. All controls are housed in one well-appointed cabin and are so arranged that one driver is able to command all motions, including travel.

The crane will operate on the free-on-wheels position or on outriggers. A number of sizes and types of jib are available to suit the operators requirements, and they range in length from 30-ft. to 75-ft., the maximum lift of 10 tons being obtained on a 30-ft. jib. The working radii, depending on the jib used, are from 10-ft. to 45-ft. Where the crane has to be continuously operated over rough ground a 6 x 6-wheel drive is available instead of the standard 6 x 4-wheel drive.

The prototype KL 10-10 has been subjected to some two years of intensive testing under the conditions likely to be met with by models in normal service. The demonstration marked the start of full production.

New Reflector Material

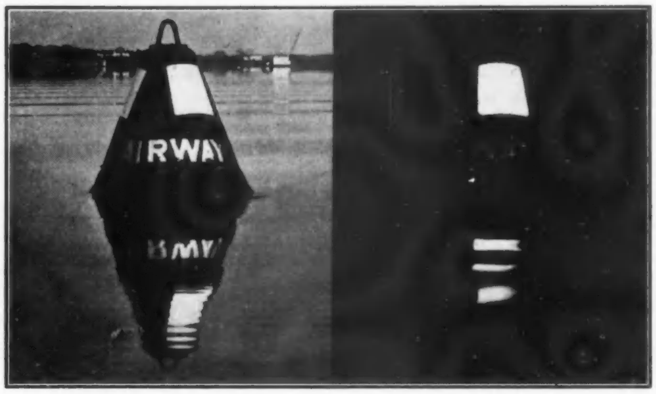
Tests are being made by a number of organisations, including the R.N.L.I., the Admiralty, Trinity House and the Port of London Authority, to examine the value of a new reflective material which is likely to have many applications for marine work. Known as " Scotchlite " reflective sheeting it is a tough, plastic reflective film to which are permanently bonded microscopic glass spheres which act as retro-reflecting lenses. Light is reflected back to its source from the sheeting with a brilliant glow but with no dazzle.

The lifeboat service was among the first to undertake tests of the new material. It was fixed to a lifeboat and life-jacket and secured at sea. With the spotlamp mounted in a lifeboat, the crew were able to pick up the glow from " Scotchlite " at three cables distance (about 900 yards). It is reported that even when submerged, strips of the material were still visible.

Further tests have taken place in the Solent where officers of the Royal Naval Submarine School, H.M.S. " Dolphin," Gosport, have been collaborating with the manufacturers, the Minnesota Mining and Manufacturing Co. Ltd., to determine its value for increasing the visibility of submarine indicator buoys and submarine escape apparatus. Good results are reported and the Submarine School is now carrying out durability tests.

Chichester Harbour, which acts as a base for well over a thousand sea-going yachts, has recently had all main buoys treated with the material. This follows tests on two buoys carried out last year.

Experiments are being conducted to determine the reflection



A harbour buoy fitted with panels of the reflector material. The illustration shows (left) the effect by day and (right) the same buoy at night.

ranges of various sizes of " Scotchlite." It is reported that preliminary tests on buoys fitted with patches of one square foot gave a reflective range of 680 yards with an Aldis lamp, and of 470 yards with a torch.

The material is weatherproof, waterproof and is not subject to deterioration by smoke and fumes.

Mineral Insulated Cables

A visit was arranged recently to Prescot, Lancashire, to enable the Press to inspect the manufacturing processes of the mineral insulated, or M.I., cable produced by British Insulated Callenders Cables Ltd.

M.I. cable consists of solid, high conductivity copper conductors embedded in compressed mineral powder, the whole being contained in a seamless copper tube which forms the sheath of the cable. The product is considered to have several outstanding properties. They are:—

(a) The copper sheath and the magnesium oxide filling do not age or deteriorate.

(b) The force of any blow on the outer sheath is transmitted equally throughout the cable so that the conductors retain their relative spacing and insulation is unimpaired.

(c) During manufacture they are fully annealed and are, consequently, ductile, which, together with their small overall diameter, permits installation in confined spaces and close fitting to the contour of the surface to which they are attached.

(d) The copper sheathing is resistant to corrosion, the patina formed on the metal by oxidation in air providing an additional protection.

When fitted M.I. cable is neat in appearance. It should have many industrial and commercial applications.

New Fire Extinguisher

A dry powder fire extinguisher announced recently is claimed to be more efficient than any other type of extinguisher of camparable size.

It is designed to combat fires involving electrical equipment and inflammable liquids of all kinds. In the hands of an experienced operator it can quell a petrol fire over an area of 14 sq. ft.

The extinguisher is $15\frac{7}{8}$-in. high and weighs $10\frac{1}{2}$ lbs. A strike knob and nozzle are fitted on the chromium-plated operating head and when the knob is struck a fan shaped cloud of powder, 4-ft. wide and 2-ft. deep, is expelled through the nozzle. It has a range in still air of 10-ft., at 65° F. The extinguisher is a total discharge model and once the seal has been pierced the flow cannot be stopped, the four pound charge of powder being discharged in eight seconds. A new pressure charge can be inserted in thirty seconds. A specially designed carrying handle enables the operator to aim at the heart of the blaze.

Approved by the Fire Officers' Committee, it is available for immediate delivery from the designers and manufacturers, Nu-Swift Ltd., Elland, Yorkshire.

Manufacturers' Announcements—continued

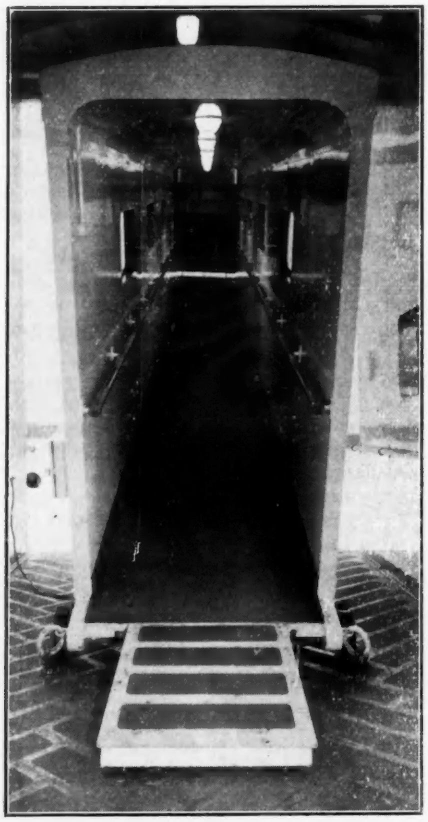
Bandox Containers

The manufacture of Bandox multi-journey collapsible containers has been taken over by Messrs. Gabriel Wade and English Ltd.

It is claimed that this container will collapse for storage or transportation purposes to a dimension that may be as low as 10 per cent. of the assembled volume. The container can be supplied, to specification, to carry any commodity of any weight. The compact nature of the collapsed container offers no voids which, when subject to impact, permit further reduction and consequent distortion with resultant insurance against claims. It is designed for a service life of some fifty journeys and is sufficiently robust to stand normal dock handling methods. No objection has been raised by Customs Officers after four years of usage.

Aluminium Gangways for Ships

The Mersey Docks and Harbour Board recently placed an order with Head Wrightson Aluminium Ltd., for four aluminium gantries and gangways for use at the Princes Landing Stage, Liverpool.



These new gangways will improve the existing method of handling passengers during embarkation and landing, and their modern design affords maximum protection from inclement weather.

Both the gangways and gantries are of double skin construction to ensure that they will stand up to constant manhandling. The travelling gantries from which the gangways are run out and hoisted by derrick to the ship's side are 37-ft. long, 10-ft. wide with headroom of 10-ft. 8-in., and the use of such a light metal greatly facilitates handling on the quay. The gantries are of welded portal construction attached to mild steel girders, and $\frac{1}{2}$-in. solid aluminium alloy rivets were used during fabrication of the gangways.

Non - slip rubber flooring was supplied by the Minesota Mining and Manufacturing Co. of Birmingham, and special attention has been given to providing effective lighting and ventilation.

New Shipborne Radar Set

A new close-range radar unit operating in the 8 mm. waveband is being produced by Philips Telecommunications Division at Hilversum, Holland. The set is designed to be used as the main radar installation on ships navigating chiefly in narrow and congested waters and as additional radar on larger ships already equipped with 3 cm. or 10 cm. navigation radar. In the latter instance the set would be used in close-quarter situations and as a standby set should the main radar break down.

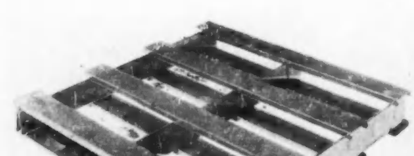
By operating on the 8 mm. waveband a very narrow beam width of about 3° is obtained with an antenna only 6-ft. wide. The very short pulse length, .02 μ sec., combined with the narrow horizontal beam width provides an extremely sharp picture on the indicator screen and nearby objects, buoys, piers, tugs, etc., are clearly shown. The antenna rotates at 40 revolutions per minute and due to its high speed changes in the situation are observed almost immediately, even when the change is rapid, as is usually the case when navigating at extremely close quarters. No connection to the ships compass or log is required and, if desired, the radar picture can be compass stabilised in the usual way. Attention has been paid to achieving a low noise level of the antenna drive and also of the indicator so that aural perception in fog will not be affected.

Philips Ship-Shape Radar, to give the installation its full title, is made up of four main components. They are: (1) Transmitter-receiver unit, housed in a waterproof light-metal casting on top of which the antenna is mounted; (2) Indicator, in a drip-proof light-metal casting and incorporating all operational controls; (3) Power supply unit, housed in a drip-proof metal cabinet; (4) Motor generator, with control cabinet.

New Flat Steel Pallets

By the incorporation of "V" section principles, a flat steel pallet possessing a very high strength to weight ratio characteristic—and yet which is available at low cost—has been designed by Fisher & Ludlow Ltd. of Birmingham.

This pallet, which has been patented throughout the world, comprises "V" section cross bearers, ribbed for additional strength, fusion welded at all points of contact to "V" shaped longitudinal flanges which form the seating base of the pressed steel slats. The result is a pallet of exceptionally robust, rigid and durable construction. As an example of the outstanding success of this design, stringent tests in connection with a Government contract for pallets measuring 48-in. x 48-in. established that a nominal capacity of 2 tons per pallet could be safely achieved with a maximum stack loading of 10 tons. Owing to simplicity in fabrication pallets can, however, be supplied in any size and to cater for any loading capacity customers may require. The Flowstack "V" Line Pallet, as it is called, is a two-way entry type, of reversible or non-reversible pattern for handling by fork-lift or hand pallet truck (suitably modified base slats being incorporated in the latter event) and provision can also be made for crane slings if desired.



Small Diesel Transport Unit

The latest addition to the Lister range of pneumatic-tyred industrial trucks is a Diesel Auto-Truck, a small transport unit that embodies features of manœuvrability and easy handling and combines with them the economic advantages of diesel engine power. The truck is light in weight, the unladen weight being approximately 9 cwt. and yet is capable of carrying a load of 2,000 lbs. and towing 1 ton. Power is provided by the Lister LD air-cooled diesel engine developing $3\frac{1}{2}$ horse power at 1,800 r.p.m. Either twin or single speed gearing can be supplied.

Performance has been proved by considerable testing. Carrying the maximum load the two-speed model gives a speed of $7\frac{1}{2}$ m.p.h. on a gradient of 1 in 31 and $3\frac{3}{4}$ m.p.h. on a gradient of 1 in 11. The single speed model has shown a speed in excess of 5 m.p.h. on a 1 in 22 gradient. Experience has shown that the average fuel consumption is under two gallons per week. By the use of a diesel power unit fire risk is reduced to a minimum and another advantage is that the pilfering of fuel is obviated. The truck is manufactured by R. A. Lister and Co. Ltd. of Dursley, Gloucestershire.